REAGENTS AND REACTIONS

TOGNOLI

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REAGENTS AND REACTIONS

Translated from the Italian.

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Trans. by G. W. Robinson.

REAGENTS AND REACTIONS

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PREFATORY NOTE BY THE TRANSLATOR

It is a common practice, more especially in foreign scientific literature, to refer to a reaction by the name of the chemist who first applied it, although, in many cases, the reaction may hardly be known outside the country of its origin.

It was, therefore, a good idea on the part of Dr. Tognoli to gather together in a convenient form most of the important chemical reactions, so that the chemist has only to refer to the alphabetical list to refresh his memory upon the details of any particular test.

Some of the reactions described in the original are practically obsolete, but I have retained them in the translation, since they are still mentioned in papers on the subjects with which they are concerned. I have also added a number of the more important reactions which were not included in the Italian edition.

Many of the tests belong to the domain of

physiological chemistry, and might, on first thoughts, seem to be outside the province of the analytical chemist; but even of these tests, some are mentioned from time to time in chemical journals, and it would be difficult to choose which should be omitted, even if the book were intended solely for the chemist; whilst they undoubtedly render the book of greater value to the medical man.

C. AINSWORTH MITCHELL

White Cottage,
The Common,
Amersham

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REAGENTS AND REACTIONS.

INTRODUCTION.

The identification of substances in chemistry is effected by transforming the substance under examination into a new compound with characteristic specific properties, by means of a known substance. This intermediary substance is termed a *reagent*, and the transformation effected a *chemical reaction*.

A chemical reagent is used, therefore, in all chemical and microscopical investigations, either for the identification of individual elements or their compounds, or for the detection and quantitative estimation of these substances in various mineral, animal, and vegetable complexes. Hence it plays a fundamental part in all the various chemical reactions which can be utilised in the numerous methods of investigation employed in bromatological, medico-legal and clinical chemistry.

Chemical reactions can take place in two ways—the wet and the dry way; and they are always made manifest by characteristic phenomena such as the formation of a precipitate, the evolution of gas, the change or appearance of a coloration.

To be able to produce a reaction or make an analysis with certainty it is necessary to know definitely not only the reactions of individual substances, but also the sensitiveness of the same

reactions. It is therefore advisable to use reagents of known concentration, and always to employ a known quantity of the different substances. In practice it is best, as proposed by Blochmann, to use normal solutions.

By a normal solution is understood a solution which contains dissolved in a litre of water the equivalent in grammes of the respective substances. Hence decinormal and centinormal solutions contain respectively $\frac{1}{10}$ and $\frac{1}{100}$ of a gramme equivalent per litre.

The reagents required for various reactions are as follows :—

(*a*) Concentrated Acids.

1. Hydrochloric acid	..	specific gravity = 1·189
2. Nitric acid	.. ..	,, ,, 1·385
3. Sulphuric acid	..	,, ,, 1·840

(*b*) Concentrated Alkalies.

1. Ammonia	.. ..	27 per cent. solution.
2. Potassium hydroxide	..	35 ,, ,,
3. Sodium hydroxide	..	35 ,, ,,

(*c*) Dilute Acids (Double Normal).

(In a litre of water.)

1. Hydrochloric acid	.. ..	72·94 grms.
2. Nitric acid	.. .. ..	126·04 ,,
3. Sulphuric acid	.. .. ..	98·09 ,,
4. Acetic acid	.. .. ..	120·06 ,,
5. Oxalic acid	.. .. ..	126 ,,
6. Tartaric acid	.. .. ..	300·1 ,,

(*d*) Dilute Alkalies (Double Normal).

(In a litre of water.)

1. Ammonia	.. .. ..	70·10 grms.
2. Potassium hydroxide	.. ..	112·22 ,,
3. Sodium hydroxide	.. ..	80·02 ,,

(*e*) Salts.

I. *Double Normal Solutions.*

(In a litre of water.)

1. Ammonium carbonate	.. ..	96·08 grms.
2. Ammonium chloride	.. ..	107 ,,
3. Sodium carbonate	.. ..	106 ,,
4. Ammonium sulphide.		

II. *Normal Solutions.*

(In a litre of water.)

1. Sodium acetate	.. ..	136·07 grms.
2. Disodium phosphate	.. ..	119·34 ,,
3. Sodium hypochlorite	.. ..	69·01 ,,
4. Sodium nitrate	.. .. ..	85·1 ,,
5. Sodium nitrite	.. .. ..	69·01 ,,
6. Potassium bichromate	..	85·1 ,,
7. Calcium chloride	.. ..	49·03 ,,
8. Magnesium sulphate	.. ..	123·25 ,,
9. Barium chloride	.. ..	122·16 ,,
10. Ferric chloride	.. .. ..	54·08 ,,
11. Potassium ferrocyanide	..	105·59 ,,
12. Lead acetate	.. .. ..	189·60 ,,
13. Stannous chloride	.. ..	113 ,,
14. Mercurous nitrate	.. ..	262·01 ,,
15. Cobalt nitrate	.. .. ..	145·54 ,,
16. Ammonium oxalate	.. ..	71·06 ,,

III. *Seminormal Solutions.*

(In a litre of water.)

1. Bismuth nitrate	.. ..	80·69 grms.
2. Mercuric chloride	.. ..	67·73 ,,
3. Sodium thiosulphate	.. ..	124·11 ,,
4. Sodium bromide	.. ..	69·48 ,,
5. Potassium cyanide	.. ..	32·56 ,,
6. Potassium iodide	.. ..	83·01 ,,
7. Potassium thiocyanate	..	48·54 ,,

8.	Zinc sulphate	71·89 grms.
9.	Copper sulphate	62·43 ,,
10.	Alum	79·08 ,,
11.	Chrome alum	83·24 ,,

IV. *Decinormal Solutions.*

(In a litre of water.)

1.	Uranium acetate	21·03 grms.
2.	Silver nitrate	16·99 ,,

Saturated Solutions.

1. Saturated solution of hydrogen sulphide.
2. Baryta water.
3. Lime water.
4. Saturated solution of calcium sulphate.
5. Chlorine water.
6. Bromine water.

Solvents.

1. Acetone.
2. Alcohol.
3. Amyl alcohol.
4. Aniline.
5. Benzene.
6. Carbon disulphide.
7. Chloroform.
8. Ether.
9. Ethyl acetate.
10. Glycerin.
11. Methyl alcohol.
12. Petroleum spirit.

TESTS OF PURITY OF THE MORE IMPORTANT REAGENTS.

ACETIC ACID.

$C_2H_4O_2 = CH_3COOH = 60.$

1. Ten grms. evaporated ought to leave no residue (non-volatile substances).

2. Ten grms. diluted with water to 100 c.c. should not show any change when neutralised with ammonia, or when treated with ammonium sulphide or with hydrogen sulphide, even after standing for twenty-four hours (absence of heavy metals).

3. A 5 per cent. solution of acetic acid should show no turbidity with barium chloride (absence of sulphates), even after the addition of chlorine water (absence of sulphurous anhydride).

4. A 5 per cent. solution to which nitric acid has been added should give no precipitate with silver nitrate (absence of chlorides).

5. One c.c. of the acid mixed with 5 c.c. of Bettendorf's reagent should not show any brown coloration after some hours (absence of arsenic).

6. Five c.c. of the acid diluted with 15 c.c. of water and treated with 1 c.c. of a 0·1 per cent. solution of potassium permanganate should retain the pink colour for at least ten minutes (absence of tarry matter).

7. A solution of mercuric oxide in acetic acid ought to remain clear when boiled (absence of formic acid).

8. It should dissolve in water, and the solution should not become turbid on the addition of ammonium oxalate (calcium salts).

9. Quantitative Estimation.—This is effected volumetrically by means of a normal solution of potassium hydroxide, phenolphthalein being used as indicator.

ACETONE.

$CH_3.CO.CH_3 = 57{\cdot}86.$

1. Acetone should boil at 56° to 57° C. and have a specific gravity of 0·812 at 0° C.

2. When evaporated on the water-bath it should not leave any residue (absence of non-volatile substances.)

3. Its reaction should be neutral; on evaporating the liquid, neutralised with sodium hydroxide if acid, taking up the dry residue with a little water, and adding a trace of ferric chloride, no blood-red coloration should appear (absence of acetic acid).

4. When diluted with water it should yield a clear solution (absence of tarry products), which should not become turbid when treated with silver nitrate, in the cold, or on heating (absence of aldehydes and reducing substances).

5. When shaken with dry calcium chloride it should not give a moist mixture (absence of moisture).

6. Quantitative Estimation.—This is based on the transformation of the acetone into iodoform by means of iodine and potassium hydroxide, and gravimetric determination of the iodoform produced (Kraemer).

ALCOHOL (ETHYL ALCOHOL).

$C_2H_5OH = 46{\cdot}05.$

1. Alcohol should be colourless and volatilise completely when heated on platinum foil (absence

of non-volatile mineral matter), and should remain colourless after the addition of ammonia (absence of tarry substances and tannin derived from the casks).

2. It should have the normal physical properties (boiling point and specific gravity). If these should be higher than normal the presence of foreign substances will be indicated.

3. It should not contain water. This, of course, only refers to absolute alcohol. When completely anhydrous it should not cause copper sulphate which has been dehydrated to turn blue. Water may be detected in alcohol by pouring a few drops of the sample on to the surface of 4 to 6 c.c. of pure benzene in a test-tube. In the presence of water the liquid becomes turbid (Gorgen). A trace of water may be detected by means of calcium carbide, which is decomposed by water with the liberation of acetylene (Vitali).

4. Its reaction should be neutral (absence of acids).

5. It should not become turbid on the addition of water (absence of resinous substances).

6. When evaporated at a low temperature alcohol should not leave a residue with the objectionable odour of amyl alcohol (absence of fusil oil). The latter is then best identified by shaking 50 c.c. of the alcohol with an equal quantity of chloroform and twice the volume of alcohol. It should not leave a malodorous residue which when treated with sulphuric acid turns black, and when heated with sodium acetate and sulphuric acid emits a pleasant pear-like odour (absence of amyl alcohol).

7. On treating 10 c.c. of alcohol, diluted with 10 c.c. of water, with 1 c.c. of an ammoniacal solution of silver nitrate, there should be no darkening; nor on adding to 10 c.c. of alcohol 1 c.c. of a 10 per cent. solution of metadiaminobenzene

should a reddish-yellow coloration appear after five minutes (absence of aldehydes).

8. When 5 c.c. of alcohol are treated with 5 c.c. of pure concentrated sulphuric acid in a test-tube, in such a manner that the two liquids do not mix, no red coloration or red-coloured ring should appear at the zone of contact (absence of alcohol prepared from molasses or from beetroot sugar).

9. On mixing 10 c.c. of alcohol with 1 c.c. of a 0·1 per cent. solution of potassium permanganate, decolorisation of the permanganate should not take place in less than twenty minutes. Should decolorisation occur sooner, and more or less rapidly, it is an indication of the presence of aldehydes, formic acid or fusel oil, or of foreign organic substances such as occur in methyl alcohol.

10. Alcohol should not become turbid nor yield a precipitate when treated with hydrogen sulphide (heavy metals).

11. On treating alcohol with 10 c.c. of aniline and 2 c.c. of acetic acid no red coloration should be produced (absence of furfural).

ALUM (POTASSIUM ALUMINIUM SULPHATE).

$$K_2Al_2(SO_4)_4.24H_2O = 948.$$

1. A solution of alum should not give a blue coloration with potassium ferricyanide (ferrous salts).

2. Potassium hydroxide should not produce a white insoluble precipitate in a solution of alum (magnesium salts).

3. On treating the solution with ammonia in excess and filtering the liquid, the filtrate should not give a white precipitate with hydrogen sulphide (zinc salts).

4. When boiled with potassium hydroxide solution it should not emit ammonia (ammonium alum).

5. The solution should not turn brown or yield a precipitate with hydrogen sulphide copper salts).

AMMONIA.

$NH_3 = 17{\cdot}03$.

1. Ammonia solution should leave no residue when evaporated in a porcelain dish (fixed mineral matter).

2. After acidification with nitric acid it should not give a precipitate with silver nitrate (chlorides), or with barium chloride (sulphates).

3. It should give no precipitate with ammonium oxalate (calcium salts).

4. On treating 5 c.c. of ammonia solution with 10 c.c. of clear lime-water and 10 c.c. of distilled water free from carbon dioxides, it should yield a clear liquid which does not become turbid even when boiled (ammonium carbonate and carbamate).

5. When treated with twice its volume of strong colourless nitric acid it should not give a yellow or red coloration (coal-tar derivatives such as aniline, pyridine, etc.).

6. It should not give a turbidity or precipitate on treatment with hydrogen sulphide (lead, iron, zinc).

7. Quantitative Estimation. Ammonia may be estimated gravimetrically as platino-chloride; but it is preferable to estimate it volumetrically by titration with a normal solution of oxalic or sulphuric acid, using methyl orange or Congo red as indicator.

AMMONIUM CARBONATE.

$(NH_4)_2CO_3 = 96{\cdot}08.$

1. Ammonium carbonate should volatilise completely without leaving a residue (fixed mineral substance).

2. It should be soluble in four parts of cold water (absence of an excessive amount of ammonium bicarbonate).

3. It should be colourless (not of a yellow colour), and when ignited should not leave a brown residue (absence of tarry substances).

4. Its solution should not darken when treated with ammonium sulphide (iron), and, after acidification with hydrochloric acid, should not darken with hydrogen sulphide (lead, copper) or become turbid with barium chloride (sulphates).

5. After acidification with nitric acid it should not give a precipitate with silver nitrate (chlorides); nor when acidified with acetic acid should it give a precipitate with ammonium oxalate (calcium salts).

AMMONIUM CHLORIDE.

$NH_4Cl = 53{\cdot}49.$

1. Ammonium chloride should be colourless. A yellow coloration may be due to the presence of iron, whilst a reddish coloration may be due to the presence of tarry substances; in the latter case a filtered aqueous solution of the salt will also be of a reddish colour. If, however, ammonium chloride of reddish colour gives, when dissolved in water and filtered, a colourless filtrate, the coloration is due to the presence of a specific micro-organism (*Oidium aurantiacum*). In that

case it is a simple matter to destroy the mould-fungus by drying the salt.

2. When calcined in a platinum vessel ammonium chloride should leave no residue (fixed mineral matter).

3. Its aqueous solution (1 : 10) should not become turbid on the addition of barium chloride (sulphates), nor give a precipitate with hydrogen sulphide after neutralisation with ammonia (heavy metals).

4. The solution, after acidification with a few drops of hydrochloric acid, should not give a blue coloration with potassium ferrocyanide (iron).

5. On evaporating 1 grm. of the salt with nitric acid (sp. gr. 1·153) to dryness on the water-bath, the residue should be white, not yellow or brown (tarry substances, aniline).

AMMONIUM MOLYBDATE.

$$(NH_4)_6Mo_7O_{24} + 4H_2O = 1234{\cdot}6.$$

1. On dissolving 1 grm. of the salt in 2·5 c.c. of water, and adding 1·5 c.c. of ammonia solution (sp. gr. 0·910) a clear solution should be obtained, and on then adding 15 grms. of nitric acid (sp. gr. 1·20) and allowing the mixture to stand for two hours while gently warmed it should not give a yellow sediment (phosphoric acid).

2. An ammoniacal solution of the salt should not alter on the addition of ammonium sulphide (heavy metals).

3. A solution to which nitric acid has been added should not alter on the addition of barium chloride (sulphates), or of silver nitrate (chlorides).

AMMONIUM OXALATE.

$(NH_4)_2C_2O_4.H_2O = 142.$

1. When the salt is calcined in a platinum vessel it should not leave any residue (non-volatile substances, alkali salts).

2. The aqueous solution should not alter when treated with hydrogen sulphide or with ammonium sulphide (heavy metals), nor should it become turbid on the addition of barium chloride (sulphates) or silver nitrate (chlorides).

3. Quantitative Estimation.—This is effected gravimetrically by precipitating the oxalic acid with calcium chloride, igniting the precipitate of calcium oxalate, and weighing the resulting calcium oxide.

AMYL ALCOHOL.

$C_5H_{11}OH = 88.$

1. Pure amyl alcohol has the following physical constants:—Specific gravity at 15° C., 0·815; boiling point, 129° to 131° C.

2. When evaporated it should not leave any residue (absence of non-volatile substances).

3. When shaken with an equal volume of sulphuric acid it should give only a yellow or, at most, a reddish coloration, not a blackish-brown one (absence of furfural).

4. On shaking amyl alcohol with water acidified with hydrochloric acid, separating the acid layer and evaporating it on the water-bath, and taking up the residue with a little water, the liquid ought not to give a precipitate with the general reagents for alkaloids, and in particular with the double iodide of potassium and mercury, with a potassium

iodide solution of iodine, etc. (absence of pyridine bases).

ANILINE.

$C_6H_5NH_2 = 93.$

1. Pure aniline has a specific gravity of 1·026 at 15° C., and boils at 182° C.

2. It should dissolve in twice its volume of hydrochloric acid to form a solution which should remain clear even when diluted with an equal quantity of water and when chilled (absence of hydrocarbons and of nitrobenzene).

3. Its reaction should be absolutely neutral, and it should leave no residue on evaporation.

BARIUM CHLORIDE.

$BaCl_2 + 2H_2O = 244.$

1. Its solution should be neutral, and not alter when treated with hydrogen sulphide (heavy metals).

2. On heating 2 grms. of the powdered salt with 10 c.c. of strong hydrochloric acid in a test-tube it should not give a yellow coloration or emit an odour of chlorine (chlorates).

3. After separation of the barium by means of sulphuric acid, the filtrate, when evaporated, should not leave any appreciable residue (alkalies, lime).

4. On shaking the powdered salt with alcohol and filtering the liquid, the filtrate ought not to give a red tint to a flame, nor on evaporation leave a deliquescent residue (chloride of calcium or strontium).

5. Quantitative Estimation.—It is estimated

gravimetrically by precipitating the barium as barium sulphate

BENZENE.

$C_6H_6 = 78.$

1. Benzene should have a neutral reaction and volatilise completely when heated on platinum foil.

2. The pure compound boils at 80·5 C., and solidifies at 0° C.

3. On shaking benzene with a few c.c. of a solution of a trace of isatin in about thirty times its volume of strong sulphuric acid, no blue coloration should be produced (presence of thiophen).

4. When treated with strong sulphuric and nitric acids it should emit the characteristic odour of bitter almonds. This reaction is particularly useful for the identification of benzene and for differentiating it from petroleum spirit.

BISMUTH NITRATE.

$Bi(NO_3)_3 + 5H_2O = 481{\cdot}11.$

1. On dissolving neutral (normal) bismuth nitrate in dilute nitric acid, and treating part of the solution with silver nitrate no turbidity should result (bismuth chloride), whilst the other part should not give a precipitate when treated with barium chloride (sulphates).

2. The nitric acid solution should not give a blue coloration with potassium ferrocyanide (ferric salts).

3. It should not become turbid on the addition of sulphuric acid (lead), nor when treated with

ammonia in excess and filtered should it yield a blue coloration (copper).

4. When a small quantity of the salt is mixed with water and boiled with sulphuric acid until all nitric acid has been eliminated, and the liquid diluted with water and tested in Marsh's apparatus, it should not produce spots or black rings (arsenic).

5. Quantitative Estimation.—The bismuth is estimated gravimetrically in the form of bismuth oxide.

BROMINE WATER.

1. On evaporating 10 to 20 c.c. of bromine water it should not leave any residue (non-volatile mineral matter).

2. Twenty c.c. of the bromine water are acidified with nitric acid and treated with silver nitrate, the resulting precipitate washed and digested with five to six times its volume of 15 per cent. ammonium carbonate solution, and the liquid filtered. The filtrate should not give a precipitate when treated with potassium bromide solution (absence of chlorine).

3. From 20 to 40 c.c. of the bromine water are heated with iron powder, and the mixture shaken until decolorised and then filtered. The filtrate, which will contain ferrous bromide (and iodide if present), is treated with a few drops of ferric chloride solution, which will not act on the bromide, but will decompose any ferrous iodide, liberating the iodine, which can be identified by means of starch paste (blue coloration) or carbon bisulphide (violet coloration) (presence of iodine).

4. On treating bromine water with potassium hydroxide or sodium hydroxide a clear liquid should be obtained, and no heavy insoluble drops should be formed (presence of organic bromine compounds).

5. Quantitative Estimation (see *Chlorine Water*).

CALCIUM CHLORIDE.

$CaCl_2 + 6H_2O = 219.$

1. When dissolved in 10 per cent. of its quantity of water it should yield a clear, neutral solution.

2. On treating the solution with ammonia it should not give a white precipitate, which would indicate aluminium, or a reddish precipitate of ferric salts.

3. The solution when rendered slightly acid with hydrochloric acid and treated with barium chloride ought not to become turbid (sulphates), and should not give a precipitate with hydrogen sulphide (heavy metals), or a blue coloration with potassium ferrocyanide (ferric salts).

4. On heating 2 grms. of the salt with sodium hydroxide solution no odour of ammonia should be developed (ammonium salts).

5. Quantitative Estimation.—The calcium is precipitated as calcium oxalate, and the precipitate ignited and weighed as calcium oxide. The chlorine is estimated gravimetrically as silver chloride.

CARBON BISULPHIDE.

$CS_2 = 76{\cdot}14.$

1. Pure carbon bisulphide has the following physical constants :—Specific gravity at 20° C. = 1·262 ; boiling point, 46° C.

2. It should have a neutral reaction (absence of acid products) and should volatilise completely when heated (absence of non-volatile substances).

3. It should not darken on treatment with lead acetate (hydrogen sulphide).

4. Water with which it has been shaken ought not to give a turbidity with barium chloride

(sulphates), or decolorise potassium permanganate (sulphur dioxide).

5. When evaporated it should not leave a residue which when heated with potassium hydroxide forms a substance which, on acidification with hydrochloric acid, emits an odour of hydrogen sulphide (sulphur).

CHLORINE WATER.

1. Chlorine water should be completely volatile. On evaporating 10 c.c. in a basin no trace of residue should be left (non-volatile mineral matter).

2. Thirty c.c. are shaken with 5 to 8 grms. of metallic mercury until the odour of chlorine has completely disappeared, when the liquid is filtered. The filtrate should not give a white precipitate with silver nitrate, nor turn red litmus paper blue (absence of hydrochloric acid).

3. Quantitative Estimation.—This is effected volumetrically by two methods: (1) Ten c.c. of the chlorine water are treated with an excess of potassium iodide solution (1 : 20), and the liberated iodine titrated with N/10 sodium thiosulphate solution, with starch paste as indicator (1 c.c. of thiosulphate solution = 0·00355 grm. of chlorine) (Wagner's method). (2) The chlorine in chlorine water is titrated with N/10 arsenious anhydride solution, with starch iodide as indicator.

CHLOROFORM.

$CHCl_3 = 119{\cdot}1$.

1. Pure chloroform has a specific gravity of 1·502 at 15° C., and boils at 62·05° C.

2. Its reaction should be neutral (absence of hydrochloric acid or acid products), and it should

volatilise completely when heated in a platinum basin (non-volatile mineral matter).

3. Water with which it has been shaken ought not to have an acid reaction, nor to give a white precipitate (hydrochloric acid) or a yellow or reddish precipitate (arsenious or arsenic acid with silver nitrate.

4. When 5 c.c. of the chloroform are shaken with 5 c.c. of a solution of zinc iodide or of cadmium iodide mixed with starch the reagent should not be coloured blue, nor should the chloroform become red (chlorine).

5. On shaking 20 c.c with 15 c.c. of strong sulphuric acid in a tube previously rinsed with the same acid, a yellowish-brown coloration should not appear after twenty-four hours (ethylene chloride, chlorides of amyl compounds).

6. When allowed to evaporate spontaneously on paper it ought not to leave a spot with an unpleasant odour (fusel oil, phosgene, etc.).

7. It should not reduce silver nitrate either in the cold or on heating, nor give a yellow or brown coloration when treated with a fragment of potassium hydroxide (aldehydes).

8. When shaken with a very dilute solution of potassium bichromate acidified with sulphuric acid it should not produce a green coloration, and it ought to remain clear and colourless on contact with magenta (absence of alcohol).

9. On shaking 20 c.c. of chloroform with 15 c.c. of strong sulphuric acid to which has been added 4 drops of formaldehyde, no coloration should appear after half an hour (absence of amyl alcohol, tertiary butyl alcohol, benzene, thiophen, amyl chloride).

10. When shaken with the iodide of ammonium and mercury it ought not to give a red coloration, due to the formation of red mercuric iodide (water).

11. Quantitative Estimation.—The chloroform

is decomposed with an excess of alcoholic potassium hydroxide solution, and the resulting liquid is acidified with nitric acid and treated with silver nitrate. The amount of chloroform is calculated from the weight of silver chloride produced.

CHROMIC ACID.

$CrO_3 = 100$ (Chromic Anhydride).

1. On treating 2 grms. of chromic anhydride with 20 c.c. of water a clear solution should be obtained, which does not become turbid or yield a precipitate when treated with a few drops of hydrochloric acid and with barium chloride (absence of sulphuric acid).

2. When 0·1 grm. is heated carefully in a porcelain basin oxygen is liberated and a green residue of chromic oxide is left. The latter when treated with water ought to be quite insoluble; the aqueous extract should be quite colourless; and when filtered and evaporated should leave no residue (absence of potassium chromate).

COBALT NITRATE.

$Co(NO_3)_2 + 6H_2O = 290{\cdot}1.$

1. A solution of cobalt nitrate (1 : 20) ought not to become turbid on the addition of barium chloride (sulphates).

2. On dissolving 2 grms. in 50 c.c. of water, adding 2 c.c. of hydrochloric acid, and treating the solution with hydrogen sulphide, no alteration should take place.

3. When 2 grms. are dissolved in water and treated with ammonia and ammonium sulphide in excess, the filtrate should leave no residue when evaporated on the water bath (alkaline salts).

COPPER SULPHATE.

$CuSO_4 + 5H_2O = 249{\cdot}72.$

1. One grm. of the salt is dissolved in 50 c.c. of water, and the solution acidified with hydrochloric acid and treated with hydrogen sulphide until precipitation of the copper is complete. The filtrate when evaporated to dryness on the water-bath ought not to leave any residue (heavy metals, alkali salts).

2. The aqueous solution, treated with ammonia in excess, ought to give a clear blue liquid, and no reddish precipitate should separate (iron salts).

3. Quantitative Estimation.—The copper is estimated gravimetrically as oxide or as sulphide, and also electrolytically as metallic copper.

ETHER.

$(C_2H_5)_2O = 74{\cdot}08.$

1. Pure ether has a specific gravity of 0·720 at 15 C. and boils at 34·6° C. When evaporated it should leave no residue (non-volatile mineral matter), and should have a neutral reaction (absence of free acids).

2. If, on evaporation, some small drops are left (water), these should not have an acid reaction, and when treated with barium chloride should not give a white precipitate (sulphuric acid).

3. It should dissolve completely in strong sulphuric acid (absence of petroleum spirit).

4. When evaporated it should not leave a residue of oily drops, which have an unpleasant odour and become black on treatment with strong sulphuric acid (amyl alcohol).

5. On shaking ether with a few drops of potassium

bichromate solution and a few drops of dilute sulphuric acid, it should not separate from the mixture as a blue layer (hydrogen peroxide), nor when shaken with potassium iodide solution should it give a yellow coloration (ozone, hydrogen peroxide).

6. When shaken with solid potassium hydroxide it should not give a yellow coloration within an hour (vinyl alcohol, ethyl aldehyde).

7. Anhydrous copper sulphate should not become blue on contact with ether, nor should blue cobalt chloride paper change to red, nor should a mixture in equal volumes of ether and carbon bisulphide yield a turbid liquid (absence of water).

8. On shaking ether with water, separating the aqueous layer, and heating it at 50° C. with potassium hydroxide and iodine it ought not to form a yellow precipitate due to iodoform (absence of alcohol); whilst on shaking 10 c.c. of ether with 10 c.c. of water in a graduated glass cylinder the aqueous layer should not increase by more than a tenth of its volume (alcohol).

9. When ether is shaken with mercury (puriss.) the surface of the metal should not become tarnished (absence of sulphur and compounds of sulphur).

10. For the detection of ethyl peroxide see *Jorissen's reaction.*

ETHYL ACETATE.

$CH_3COOC_2H_5 = 88.$

1. The pure compound has a specific gravity of 0·899 at 15° C. and boils at 72·8° C.

2. It should have a pleasant aroma, be neutral in reaction, and should volatilise completely (acid substances, non-volatile mineral matter).

3. On mixing 10 c.c. of ethyl acetate with 10 c.c. of water in a graduated cylinder the volume of the aqueous layer should not exceed 11 c.c. (alcohol).

4. On pouring 1 c.c. of ethyl acetate on to the surface of 1 c.c. of strong sulphuric acid no coloration should be formed at the zone of contact (organic secondary products, amyl derivatives).

5. When shaken with anhydrous copper sulphate it should not cause the salt to turn blue (water).

6. When distilled at a low temperature on the water-bath it should not leave a residue with a pear-like odour (amyl acetate).

7. On shaking a small quantity of ethyl acetate with a little water having in suspension magnesium oxide, and separating and filtering the aqueous layer, the filtrate should not give a red coloration with ferric chloride (acetic acid) or turbidity with barium chloride (sulphuric acid).

FERROUS SULPHATE.

$FeSO_4 + 7H_2O = 278{\cdot}03.$

1. A solution of ferrous sulphate should have a slight but not pronounced acid reaction, and on triturating the salt with anhydrous alcohol and evaporating the alcoholic solution it should not leave a residue which gives a red coloration with salicin and effervesces with sodium carbonate (absence of free sulphuric acid).

2. The aqueous solution should not give a blood-red coloration when treated with potassium thiocyanate (ferric salts).

3. The solution should not darken on treatment with hydrogen sulphide (heavy metals), and when treated with ammonia in excess it should not give a blue filtrate, but should remain colourless (copper).

4. When tested in Marsh's apparatus the solution should not yield black rings or spots (arsenic).

5. On heating a crystal of ferrous sulphate with a concentrated solution of potassium hydroxide no odour of ammonia should be perceptible (presence of ferrous ammonium sulphate).

6. Quantitative Estimation.—The solution of ferrous sulphate is titrated with N 10 potassium permanganate solution, or with N/10 potassium bichromate solution, potassium ferricyanide being used as indicator.

FERRIC CHLORIDE.

$$Fe_2Cl_6 + H_2O = 541.$$

1. When a rod is dipped into a solution of ferric chloride and then brought close to a rod which has been dipped in ammonia solution, there should be no appearance of white fumes between the rods (free hydrochloric acid).

2. Starch-iodide paper should not turn blue when brought close to a vessel containing ferric chloride solution (free chlorine).

3. When the solution, after dilution with twenty times its volume of water, is acidified with hydrochloric acid and then tested with potassium ferricyanide, it should not give a blue coloration (ferrous salts).

4. The solution is diluted with water and treated with ammonia in excess. The filtrate should not give a blue coloration (copper), but should remain colourless. On evaporating a portion of the filtrate it should not leave any residue (fixed substances), whilst a second portion when treated with hydrogen sulphide should not yield a white precipitate (zinc), or a coloured precipitate (copper,

lead, arsenic). A third portion of the filtrate, acidified with hydrochloric acid, should not give a turbidity with barium chloride (sulphates). Lastly, on heating a portion of the filtrate to remove ammonia, cooling it, adding strong sulphuric acid, and introducing ferrous sulphate solution in such a way as not to mix the two liquids, a brown ring should not be formed at the zone of contact (nitric acid).

5. The solution should not yield a black ring or spot when tested in Marsh's apparatus (arsenic).

6. It should not decolorise potassium permanganate solution (nitrous acid).

7. It should not become turbid on boiling, or on the addition of four times its volume of concentrated alcohol (ferric oxychloride).

8. Quantitative Estimation.—This is effected gravimetrically by precipitating the iron with ammonia, and igniting and weighing the precipitated ferric oxide. Or for a volumetric estimation the solution of ferric chloride may be treated with an excess of a standard solution of stannous chloride, and the excess titrated with N/10 iodine solution. Ferric chloride may also be titrated with titanium trichloride, potassium thiocyanate being used as indicator.

GLYCEROL (GLYCERIN).

$C_3H_8O_3 = 92{\cdot}06.$

1. The solution obtained by dissolving 10 c.c. in 50 c.c. of water should be neutral, and should not give a brown coloration with hydrogen sulphide, or with ammonium sulphide, nor should it become turbid on the addition of barium chloride (sulphates), ammonium oxalate (calcium salts), calcium chloride (oxalic acid), or silver nitrate (chlorides).

2. On treating 1 c.c. of glycerol with 5 c.c. of Bettendorf's reagent no coloration should appear within an hour (arsenic).

3. When heated on platinum foil it should volatilise without leaving a residue (fixed mineral substances), and it should have a neutral reaction (absence of acids and bases), and be completely soluble in water and in alcohol (absence of gum and dextrin).

4. It should not emit an odour of rancid butter, even when heated with dilute sulphuric acid (absence of butyric acid).

5. When treated with an equal volume of ammoniacal silver nitrate solution it should not give a brown coloration (acrolein, formic acid).

6. It should not reduce Fehling's solution (dextrose), even after prolonged boiling with hydrochloric acid (sucrose).

7. It should not give a precipitate on the addition of ammonia, ammonium chloride, and sodium phosphate (magnesium chloride).

8. The physical constants should be determined, and especially the specific gravity, which should be 1·269 at 15° C.

HYDROCHLORIC ACID.

$HCl = 36{\cdot}5$.

1. On evaporating 10 grms. in a basin no appreciable residue should be left (fixed substances).

2. The acid diluted with 10 volumes of water ought not to turn starch-iodide paper blue (chlorine), nor change under the action of hydrogen sulphide (heavy metals).

3. The solution diluted as above and treated with barium nitrate, either with or without the

subsequent addition of iodine until the liquid has a slight yellow colour, ought not to become turbid, or give a precipitate (sulphuric and sulphurous acid).

4. When treated with potassium ferrocyanide it ought not to give a blue coloration or precipitate (ferric salts).

5. When 100 c.c. of the acid suitably diluted are treated with arsenic-free zinc in Marsh's apparatus no reaction should be obtained even after twelve hours (absence of arsenic).

6. Quantitative Estimation.—This is effected gravimetrically in the form of silver chloride, or volumetrically by means of N-potassium hydroxide solution, with phenolphthalein as indicator.

IODINE.

I = 127.

1. Iodine should volatilise completely when heated on platinum foil (absence of fixed mineral substances: graphite, carbon, etc.).

2. Twenty-five grms. of iodine are shaken with 100 c.c. of water, the liquid filtered, and the yellow filtrate divided into two portions: (*a*) To one portion is added dilute sodium thiosulphate solution until the colour is removed, when a crystal of ferrous sulphate is introduced, followed by a few drops of solutions of ferric chloride and of sodium hydroxide, and the mixture is heated for a few minutes at 40° to 50° C. When cold, the liquid is acidified with dilute hydrochloric acid. It should not give a blue coloration or precipitate (cyanogen iodide). (*b*) The other portion, not decolorised with thiosulphate, is treated with 1 drop of ammonia solution, and an excess of silver nitrate solution, and then shaken and filtered. The filtrate when acidified with nitric acid ought not to

become turbid, or give a white precipitate (iodine chloride).

3. Quantitative Estimation. A solution is prepared by shaking 0·1 grm. of the iodine with 25 c.c. of an aqueous solution of 1 grm. of potassium iodide, and the iodine is titrated with N/10 sodium thiosulphate solution, starch paste being used as indicator. Under these conditions iodine, corresponding to 99·04 per cent. of pure iodine, requires 7·8 c.c. of N/10 thiosulphate solution.

LEAD ACETATE.

$$Pb(C_2H_3O_2)_2 + 3H_2O = 378{\cdot}99.$$

1. Five grms. of the salt are dissolved in 100 c.c. of water, treated with a slight excess of dilute sulphuric acid, and filtered. On treating the filtrate with ammonia in excess it ought not to give a blue coloration (copper), nor after evaporation and ignition should it leave an appreciable residue (foreign metals in general).

MAGNESIUM SULPHATE.

$$MgSO_4 + 7H_2O = 246{\cdot}50.$$

1. A solution of the salt slightly acidified ought not to give a turbidity with hydrogen sulphide (lead, copper), nor turn blue on the addition of potassium ferrocyanide (iron).

2. When acidified with nitric acid it ought not to give a precipitate with barium chloride (sulphates) or with silver nitrate (chlorides); nor when rendered alkaline with ammonia and treated with ammonium chloride in excess and ammonium oxalate should it give a white precipitate (calcium salts).

3. On igniting a mixture of the salt with an equal weight of charcoal and taking up the residue with water the filtrate should not give a violet coloration with sodium nitroprusside (alkali sulphates).

4. On treating the solution with an excess of a concentrated solution of potassium hydroxide, filtering the liquid, and adding an excess of ammonium chloride to the filtrate it ought not to yield a white gelatinous precipitate (aluminium).

5. When 1 grm. of the salt is powdered and mixed with 5 c.c. of Bettendorf's reagent it should not give a brown coloration (arsenic).

6. Quantitative Estimation.—The magnesium is estimated gravimetrically as magnesium pyrophosphate, and the sulphuric acid as barium sulphate.

MERCURIC CHLORIDE.

$HgCl_2 = 270{\cdot}9.$

1. Mercuric chloride should be completely soluble in alcohol, and not leave an insoluble residue which turns black on the addition of potassium hydroxide solution, and then yields a filtrate which, after acidification with nitric acid, gives a turbidity with silver nitrate (mercurous chloride).

2. A solution of mercuric chloride should not emit an odour of ammonia when boiled with potassium hydroxide (ammonium chloride).

3. The solution when treated with excess of hydrogen sulphide yields a precipitate, which when washed and treated with dilute ammonia solution should give a filtrate which on acidification with hydrochloric acid ought not to give a yellow coloration (arsenic). The filtrate from the hydrogen sulphide treatment should not leave any residue on evaporation (absence of alkali and alkaline earth metals).

4. On treating the salt with ether it should not leave an insoluble residue which reduces Fehling's solution (sugar).

5. Quantitative Estimation. - This may be effected gravimetrically as sulphide or as mercurous chloride, and electrolytically as metallic mercury. For a volumetric estimation an alkaline solution of the salt is treated with an excess of a standard solution of a ferrous salt, and the excess titrated with N 10 potassium permanganate solution.

MERCUROUS NITRATE.

$Hg_2(NO_3)_2 + 2H_2O = 560.$

1. When heated in a porcelain basin, it should leave no residue (fixed foreign substances).

2. One grm. of the salt should dissolve in 1 c.c. of water containing 3 drops of 25 per cent. nitric acid, yielding a clear solution, without any separation of a yellow powder (basic mercury nitrate).

3. On mixing 1 grm. of the salt with 1 grm. of sodium chloride and 10 c.c. of water, and filtering the liquid, there should not be a white, yellow, or grey residue (basic salt), and the filtrate should not give a precipitate with stannous chloride, ammonia, or hydrogen sulphide (mercuric nitrate).

4. Quantitative Estimation. - The mercury is estimated gravimetrically as mercurous chloride, or electrolytically as metallic mercury.

METHYL ALCOHOL.

$CH_3OH = 31{\cdot}93.$

1. Pure methyl alcohol boils at 65° to 66° C., and has a specific gravity of 0·7997 at 15° C.

2. It should have a neutral reaction and be

completely volatile (absence of acid products and fixed substances).

3. When treated with a solution of magenta which has been decolorised with sulphur dioxide it should not become pink (absence of aldehydes).

4. When shaken with twice its volume of strong sulphuric acid it should not give a yellow or brown coloration (absence of tarry substances).

5. When shaken with alcoholic potassium hydroxide solution it should not turn yellow or brown, and should not decolorise a 0·01 per cent. solution of potassium permanganate which has been added to it in the proportion of a fifth of its volume (absence of a notable quantity of aldehydes).

6. It should not contain acetone. The test is made by treating 1 c.c. of the methyl alcohol with 10 c.c. of a dilute solution of potassium hydroxide, and adding, little by little, a potassium iodide solution of iodine; in the presence of acetone a yellow precipitate of iodoform will be obtained.

7. Quantitative Estimation.—The method is based on the transformation of the methyl alcohol into dimethyl iodide. Fifteen grms. of phosphorus di-iodide are placed in a flask which is fitted with a thistle-funnel with a stop-cock, and is connected with a distillation apparatus, and 5 c.c. of the methyl alcohol are introduced, drop by drop, through the thistle-funnel, and then 5 c.c. of a solution of 1 part of iodine in 1 part of hydriodic acid (sp. gr. 1·7). After five minutes the flask is heated on the water bath, and the distillate is collected in a graduated cylinder partially filled with water. After the distillation the condenser is washed with a little water, and the washings collected in the cylinder. The contents of the latter are diluted to a definite volume with water, shaken and allowed to stand, and the volume in c.c. of methyl iodide which separates is measured.

Five c.c. of pure anhydrous methyl alcohol yield 7·2 c.c. of methyl iodide.

NITRIC ACID.

$HNO_3 = 63$.

1. Nitric acid should leave no residue when evaporated in a basin (fixed mineral substances).

2. When diluted with ten volumes of water it should not give a turbidity with barium chloride (sulphates), or with silver nitrate (chlorides), or a blue coloration with potassium ferrocyanide (ferric salts).

3. When diluted with twice its volume of water and shaken with chloroform it should not colour the latter violet, even after the addition of a fragment of metallic zinc to the acid layer (absence of iodine and iodic acid).

4. Quantitative Estimation.—This is effected volumetrically by titration with N-potassium hydroxide solution, with phenolphthalein or turmeric tincture as indicator.

OXALIC ACID.

$C_2H_2O_4 + 2H_2O = 125{\cdot}64$.

1. Oxalic acid should be perfectly white, and soluble in water.

2. When heated it should volatilise completely (absence of fixed substances).

3. On treating its solution with potassium acetate it ought not to give a crystalline precipitate (absence of tartaric acid).

4. Its solution acidified with nitric acid ought not to become turbid with silver nitrate, or with barium chloride (absence of chlorides and sulphates).

5. The solution, when acidified with sulphuric acid and treated with a crystal of brucine, should not give a red coloration (absence of nitric acid).

6. When treated with hydrogen sulphide the solution should not become turbid or give a precipitate, even after neutralisation with ammonia (absence of heavy metals).

7. On boiling the solution with potassium hydroxide it should not emit alkaline vapours with an odour of ammonia (ammoniacal salts).

8. Quantitative Estimation.—Oxalic acid may be estimated gravimetrically by precipitating it as calcium oxalate, igniting the precipitate, and weighing the resulting calcium oxide. For volumetric estimation it may be titrated with a normal solution of potassium or sodium hydroxide, with phenolphthalein as indicator, or with N/10 potassium permanganate solution.

PETROLEUM SPIRIT (BENZINE).

1. When evaporated it should not leave any appreciable residue.

2. When shaken with 1 part of strong sulphuric acid and 4 parts of nitric acid it should not, after cooling, emit an odour of bitter almonds (benzene), nor give an intense brown coloration.

3. When 1 c.c. of petroleum spirit is mixed with 5 c.c. of an ammoniacal solution of silver nitrate and heated for a short time, the mixture should not become black (absence of sulphur compounds).

PHENOL.

$C_6H_5OH = 94{\cdot}05.$

1. Phenol should be crystalline and colourless, and should volatilise completely when heated on platinum foil (fixed mineral substances).

2. It should melt at 42° to 43° C. (absence of cresol, which melts at 35° C.) and should be soluble in fourteen to fifteen times its volume of water (cresol).

3. It should not give a black coloration with sulphuric acid (tarry substances).

4. Quantitative Estimation.—This may be effected gravimetrically by precipitating the phenol with bromine water, and weighing the resulting tribromphenol. A more accurate method is to estimate the phenol volumetrically by treating it with a measured excess of bromine (derived from a standard solution of potassium bromide and bromate), then adding potassium iodide, and titrating the liberated iodine with N/10 sodium thiosulphate solution, with starch paste as indicator.

PHOSPHORIC ACID.

$H_3PO_4 = 98{\cdot}02.$

1. Phosphoric acid should not decolorise a sulphuric acid solution of indigo, nor, when its solution is treated with a solution of ferrous sulphate in such a way that the two liquids do not mix, should a brown ring be formed at the zone of contact (nitric acid).

2. The acid diluted with water (1 : 3) should not become turbid on the addition of barium chloride (sulphates), or silver nitrate (chlorides).

3. When treated with five times its volume of Bettendorf's reagent it should not give a brown coloration, even after three or four hours (arsenic).

4. It should not yield a white precipitate on treatment with mercuric chloride solution, nor decolorise 0·1 per cent. potassium permanganate solution (lower acids of phosphorus).

5. The solution when acidified with hydrochloric

acid and treated with hydrogen sulphide should not give a turbidity or precipitate (heavy metals).

6. The solution should not become turbid on the addition of alcohol and ammonia in slight excess (acid phosphates of calcium and magnesium).

7. It should not leave any residue after long-continued ignition on platinum foil (fixed substances).

8. When diluted with ten times its volume of water it should not precipitate albumin (meta-phosphoric acid).

9. Quantitative Estimation.—Phosphoric acid is estimated gravimetrically as magnesium pyro-phosphate, by precipitating it as ammonium magnesium phosphate by means of magnesia mixture and igniting the salt thus obtained.

It may also be estimated gravimetrically as ammonium phosphomolybdate.

The volumteric estimation of free phosphoric acid presents some difficulty owing to its behaving in a special way with indicators. It reacts with phenolphthalein first as regards two atoms of hydrogen, whilst in the case of the third atom it only reacts after methyl orange has been added.

It may also be estimated volumetrically by using a standard solution of uranyl acetate, with potassium ferrocyanide as an outside indicator. In the presence of excess of uranyl acetate a red precipitate is obtained.

POTASSIUM BICHROMATE.

$K_2Cr_2O_7 = 294{\cdot}20.$

1. A solution of the salt, acidified with hydrochloric acid, should not give a precipitate with barium chloride (absence of sulphates), nor, when strongly acidified with nitric acid, should it give

a precipitate with silver nitrate (exclusion of chlorides).

2. On treating the solution with ammonia and ammonium oxalate, it should not give a white precipitate insoluble in acetic acid (absence of calcium salts).

POTASSIUM BROMIDE.

$KBr = 119$.

1. A solution of potassium bromide should not turn yellow on treatment with dilute hydrochloric acid (bromates), nor have an alkaline reaction, nor become turbid with lime water (potassium carbonate).

2. The solution, when acidified with hydrochloric acid, should not give a turbidity with barium chloride (potassium sulphate).

3. When treated with a drop of potassium nitrite solution and with starch paste and hydrochloric acid, it should not give a blue coloration (potassium iodide).

4. On distilling 5 grms. of the bromide with 5 grms. of potassium chromate and 15 grms. of pure sulphuric acid in a small retort connected with a receiver containing dilute ammonia solution, the distillate should not have a yellow colour (chlorides).

5. On boiling a mixture of 1 part of bromide with 1 part of iron filings, 1 part of zinc dust, 1 part of potassium hydroxide, and 5 parts of water there should be no evolution of ammonia (nitrates).

6. The solution ought not to darken on treatment with hydrogen sulphide (heavy metals), nor give a blue coloration with potassium ferrocyanide (iron salts).

7. No precipitate should be obtained on mixing a solution of the salt with ammonia and sodium phosphate (magnesium bromide).

8. On heating a crystal of the salt in a Bunsen flame, it should not impart a yellow colour to the flame (sodium salts).

9. Quantitative Estimation.—Three grms. of the salt (previously dried at 110° C.) are dissolved in 100 c.c. of water. Ten c.c. of the solution are diluted with 70 c.c. of water, and titrated with N/10 silver nitrate solution, with potassium chromate as indicator. Not more nor less than 25·4 c.c. of the silver nitrate solution should be required. A greater or smaller quantity indicates the presence of chlorides or iodides in the salt.

POTASSIUM CYANIDE.

KCN = 65.

1. An aqueous solution of the salt (1 : 20) should not effervesce on the addition of hydrochloric acid (potassium carbonate).

2. The acidified solution should not give a brown or black coloration on treatment with hydrogen sulphide (heavy metals), nor blacken lead acetate paper (potassium sulphide), nor give a turbidity with barium chloride (potassium sulphate).

3. The solution when slightly acidified with hydrochloric acid should not give a reddish colour with ferric chloride (potassium thiocyanate), or a blue coloration (potassium ferrocyanide).

4. Quantitative Estimation.—Ten c.c. of a 1 per cent. aqueous solution of potassium cyanide are diluted with 90 c.c. of water, a trace of sodium chloride solution added, and the liquid titrated with N/10 silver nitrate solution until a faint persistent turbidity is obtained. Not less than 7·5 c.c. of the silver nitrate solution should be consumed, since potassium cyanide should contain at least 97·5 per cent. of KCN.

POTASSIUM FERRICYANIDE.

$K_3Fe(CN)_6 = 229.$

1. When crystals of potassium ferricyanide are washed superficially with water, and the solution, which should be extremely dilute, is treated with ferric chloride solution, there should not be any blue coloration (potassium ferrocyanide).

2. On acidifying 10 c.c. of a 3 per cent. solution of the salt with 2 drops of hydrochloric acid and adding barium chloride no turbidity or precipitate should be obtained (potassium sulphate).

3. A mixture of 0·5 grm. of ferricyanide and 1 grm. of potassium nitrate absolutely free from chloride is fused in a porcelain crucible, the fused mass taken up with water and filtered, and the filtrate acidified with nitric acid and treated with silver nitrate. A white precipitate should not be obtained (absence of potassium chloride)

POTASSIUM FERROCYANIDE.

$K_4Fe(CN)_6 + H_2O = 422.$

1. When a few crystals are dissolved in water, and the solution treated with dilute sulphuric acid, there should be no effervescence (potassium bicarbonate).

2. Ten c.c. of a 5 per cent. solution acidified with 2 drops of hydrochloric acid should not give a precipitate on the addition of barium chloride (potassium sulphate).

3. Detection of Chlorides.—The test is applied in the same way as in the case of potassium ferricyanide (*q.v.*).

POTASSIUM HYDROXIDE.

KOH = 56·16.

1. Five grms. of the potassium hydroxide are dissolved in 10 c.c. of water in a platinum basin, and the solution acidified with acetic acid, then rendered slightly alkaline with ammonia, diluted with water to 100 c.c., boiled on the water-bath so long as an odour of ammonia is perceptible, and then allowed to stand for some hours. There should be no separation of a white, gelatinous, flocculent precipitate (alumina).

2. The aqueous solution should not become turbid with ammonium oxalate (calcium), or with sodium phosphate (magnesium), nor show any alteration on treatment with ammonium sulphide (heavy metals).

3. Five grms. are dissolved in a platinum basin, the solution treated with hydrochloric acid in excess, and evaporated on the water-bath, and the residue heated for some hours in an oven at 150° C. When the residue is taken up with water, it should give a clear solution, and there should be no separation of a white deposit (silica).

4. Six grms. of the sample are dissolved in 200 c.c. of water, and the solution acidified with hydrochloric acid. Half of the solution is treated with barium chloride and the other half with sulphuric acid, and both are boiled for ten minutes, and then allowed to stand for six hours. There should be no precipitate or turbidity formed, in the first case indicating sulphates, and in the second barium salts.

5. The solution, when acidified with nitric acid, should give only a faint opalescence with silver nitrate (chlorides).

6. Fifty grms. of the sample are dissolved in

200 c.c. of water, and the solution treated with 5 grms. of arsenic-free iron which has been reduced by means of hydrogen, or with zinc dust, and distilled, and the distillate is collected in 20 c.c. of water containing 1 per cent. of sulphuric acid. The distillate is rendered alkaline with potassium hydroxide and treated with Nessler's reagent. It should not give a yellow coloration or precipitate (absence of nitric and nitrous acids).

7. On treating 5 grms. of the sample with 30 grms. of alcohol (sp. gr. 0·83) it should yield a clear colourless solution (absence of potassium carbonate).

8. Quantitative Estimation. -This is effected volumetrically by titrating the potassium hydroxide with N 10 sulphuric or hydrochloric acid, with phenolphthalein or litmus tincture as indicator.

POTASSIUM IODIDE.

KI = 166·12.

1. On introducing a small quantity of the previously powdered and dried salt into a colourless gas flame, it should give a pronounced violet coloration, without any yellow coloration (sodium salts).

2. A solution of 0·5 grm. of the iodide in 10 c.c. of water is treated with a drop of phenolphthalein solution. If a pink coloration is obtained potassium carbonate is present. The latter may also be quantitatively estimated by titration with N/100 hydrochloric acid. One grm. of potassium iodide should require not more than 1·4 c.c. of the standard acid for neutralisation.

3. The solution should not yield a turbidity or precipitate with hydrogen sulphide (heavy metals, especially copper and lead).

4. The solution, when acidified with hydrochloric acid, ought not to become turbid with barium chloride (sulphates).

5. On treating 10 c.c. of a 5 per cent. aqueous solution of the salt with a crystal of ferrous sulphate, adding a drop of ferric chloride solution and 5 c.c. of sodium hydroxide solution, heating the liquid slightly, and then acidifying it with hydrochloric acid, it should not give a blue coloration (potassium cyanide).

6. When 10 c.c. of a recently prepared 5 per cent solution are treated with 10 drops of freshly made starch paste and 20 drops of sulphuric acid no blue coloration should appear within five minutes (potassium iodate).

7. The aqueous solution should not give a blue coloration with potassium ferrocyanide (iron salts).

8. One grm. of the iodide is dissolved in 5 c.c. of 10 per cent. sodium hydroxide solution, 0·5 grm. of zinc dust added, and the liquid gently heated. There should be no evolution of ammonia, recognisable by its odour and by its action on red litmus paper (nitrates).

POTASSIUM NITRATE.

$KNO_3 = 101{\cdot}11.$

1. A solution of the salt acidified with nitric acid should not give a turbidity with barium chloride (sulphates) or with silver nitrate (chlorides).

2. The solution rendered alkaline with ammonia, and treated with ammonium chloride and ammonium oxalate, should not give a white precipitate (calcium salts), whilst the filtrate from any precipitate should not become turbid on the addition of sodium phosphate (magnesium).

3. When the salt is treated with alcohol and the alcoholic extract is evaporated it should not leave a residue which imparts a yellow coloration to a flame (sodium nitrate).

4. On treating the solution with potassium iodide, starch paste, and dilute sulphuric acid it should not give a blue coloration (potassium nitrate).

5. When the solution is treated with pure potassium iodide, starch paste, and tartaric acid it should not give a blue coloration (potassium iodate).

6. The solution ought not to change when treated with hydrogen sulphide (heavy metals), nor give a blue coloration with potassium ferrocyanide (ferric salts).

7. When 1 grm. of potassium nitrate is gently ignited, the residue dissolved in a little water, and the solution acidified with nitric acid and treated with silver nitrate, no white turbidity should be produced (potassium chlorate and perchlorate).

POTASSIUM NITRITE.

$KNO_2 = 85$.

1. On treating a solution of the salt with acetic acid, evaporating it to dryness on the water-bath, and dissolving the residue in a little water, the solution, acidified with sulphuric acid, should not give a red coloration with brucine, or a blue coloration with diphenylamine (potassium nitrate).

2. The solution, acidified with nitric acid, should not give a precipitate with barium chloride (sulphates), nor with silver nitrate (chlorides).

3. Quantitative Estimation.—This is effected volumetrically by titrating the nitrous acid with N/100 potassium permanganate solution.

POTASSIUM PERMANGANATE.

$KMnO_4 = 158{\cdot}03$.

1. A solution of 0·5 grm. of the salt in 25 c.c. of water is boiled with 3 c.c. of alcohol, until the liquid above the precipitate becomes colourless. The filtrate, acidified with nitric acid, should not become turbid on the addition of barium chloride (sulphates), or of silver nitrate (chlorides).

2. When 0·5 grm. of the salt is treated with 5 c.c. of boiling water, the liquid decolorised with oxalic acid and filtered, and the filtrate treated with 2 c.c. of strong sulphuric acid and 1 c.c. of ferrous sulphate solution, a brown ring should not be formed at the zone of contact of the two layers of liquid (nitrates).

3. Quantitative Estimation.—This is effected volumetrically by titrating the permanganate solution with N-oxalic acid solution, or, better, with standard ferrous ammonium sulphate solution.

POTASSIUM PERSULPHATE.

$K_2S_2O_8 = 270{\cdot}34$.

1. A solution of the salt should not give a precipitate, in the cold, with barium chloride (potassium sulphate).

2. Quantitative Estimation.—This may be effected volumetrically in various ways:—(*a*) On boiling a solution for a long time, the potassium persulphate is decomposed into neutral (normal) sulphate and free sulphuric acid, whilst oxygen is liberated. The sulphuric acid produced may be titrated with N-potassium hydroxide solution, and calculated into the corresponding amount of persulphate. (*b*) The solution of persulphate is

titrated with an excess of a standard solution of ferrous sulphate, and the excess of ferrous salt not oxidised by the persulphate then titrated with N 10 potassium permanganate solution. (*c*) The solution of potassium persulphate is treated with a measured excess of standard oxalic acid solution in presence of a trace of silver nitrate. The oxalic acid is decomposed (with liberation of carbon dioxide), the excess of oxalic acid is titrated with potassium permanganate solution, and the amount of persulphate calculated from the result.

POTASSIUM THIOCYANATE.

$KCNS = 97{\cdot}1.$

1. An aqueous solution of the salt (1 : 20) ought not to give a turbidity with barium chloride (sulphates), nor form a precipitate on the addition of ammonium sulphide (heavy metals).

2. The solution (1 : 20) should remain absolutely colourless when treated with dilute hydrochloric acid (HCl of sp. gr. 1·19, 1 c.c. + water 10 c.c.), and not give a red coloration (iron).

3. Quantitative Estimation. This is effected volumetrically by treating the solution with an excess of silver nitrate solution, acidifying the liquid with nitric acid, adding ferric ammonium alum as indicator, and titrating the excess of silver nitrate with N/10 potassium thiocyanate solution.

SILVER NITRATE.

$AgNO_3 = 169{\cdot}89.$

1. On treating 1 c.c. of a 20 per cent. solution of the salt with 15 c.c. of absolute alcohol it should not give a permanent crystalline precipitate

(potassium nitrate), nor a white turbidity (silver chloride).

2. One c.c. of the 20 per cent. solution treated with 5 c.c. of ammonia solution should give a clear colourless liquid—not a blue coloration (copper), or white turbidity (bismuth, lead).

3. The solution when treated with excess of hydrochloric acid and filtered should yield a filtrate which leaves no residue when evaporated on the water-bath (foreign salts).

4. A few drops of the 20 per cent. solution are added to a solution of 0·1 grm. of potassium iodide in 10 c.c. of water, containing starch paste and a few drops of dilute sulphuric acid. A blue coloration should not immediately appear (silver nitrite).

5. Quantitative Estimation.—The silver may be precipitated as silver chloride, and the precipitate ignited and weighed. Or it may be estimated volumetrically by titration with N-sodium chloride solution or N-potassium thiocyanate solution (Volhard).

SODIUM ACETATE.

$NaC_2H_3O_2 + 3H_2O = 136{\cdot}12.$

1. Sodium acetate should dissolve in strong sulphuric acid without becoming brown (tarry substances).

2. A 5 per cent. solution should not alter when treated with hydrogen sulphide (heavy metals).

3. The 5 per cent. solution, acidified with nitric acid, should not give a turbidity with barium chloride (sulphates), nor with silver nitrate (chlorides). Nor should it, when acidified with acetic acid, give a turbidity with ammonium oxalate (calcium salts).

4. A 5 per cent. solution acidified with hydrochloric acid should not give a blue coloration when treated with a few drops of potassium ferrocyanide (ferric salts).

SODIUM BROMIDE.

$NaBr = 103$.

1. On introducing a crystal of the salt into a colourless gas flame, a violet coloration, more visible when viewed through cobalt glass, should not be obtained.

2. All the other tests are the same as those given for potassium bromide.

3. Quantitative Estimation.—Since commercial bromine always contains a small amount of chlorine a certain proportion of chlorine may also be tolerated in sodium bromide, but it must not exceed 1 per cent. The bromide is estimated as follows:—Three grms. of the previously dried and anhydrous salt are dissolved in 100 c.c. of water, and 10 c.c. of this solution are titrated with N/10 silver nitrate solution in presence of a few drops of potassium chromate solution. They should consume not more than 29·3 c.c. of the silver solution. Under these conditions the sodium bromide would contain about 0·8 per cent. of sodium chloride.

SODIUM CARBONATE.

$Na_2CO_3 + 10H_2O = 286{\cdot}16$.

1. On evaporating 20 grms. of the salt in a platinum basin with an excess of dilute hydrochloric acid, drying the residue for some hours at

120° C., and then dissolving it in water acidified with hydrochloric acid, a clear solution free from a white flocculent deposit should be obtained (absence of silicic acid).

2. The solution, acidified with nitric acid, should not give a precipitate with silver nitrate (chlorides), nor with barium chloride (sulphates). When acidified with hydrochloric acid it should not give a turbidity or precipitate with hydrogen sulphide (heavy metals), even after neutralisation with ammonia (iron, manganese).

3. The solution when treated with hydrochloric acid should not emit hydrogen sulphide, recognisable by its darkening action on lead acetate paper (absence of sodium sulphide).

4. The solution should be clear (absence of calcium salts), and should not yield a white precipitate on the addition of a few drops of potassium nitrite solution and sufficient hydrochloric acid to make the liquid acid (absence of thiosulphate).

5. The solution, neutralised with hydrochloric acid, should not give a red coloration with ferric chloride (thiocyanates).

6. The solution, when acidified with hydrochloric acid and then treated with an excess of pure concentrated potassium hydroxide solution, should not give a white precipitate soluble in excess of the reagent, and reprecipitated by ammonium chloride (alumina).

7. On heating the solution with pure sodium hydroxide no odour of ammonia should be perceptible (ammonium salts).

8. When the solution is tested with pure sulphuric acid in Marsh's apparatus arsenical spots or rings should not be obtained (arsenic).

9. Quantitative Estimation.—A solution of the salt is titrated while hot with N/10 oxalic acid solution, litmus tincture being used as indicator.

SODIUM HYDROXIDE.

$NaOH = 40$.

The tests of purity are the same as those given for potassium hydroxide.

SODIUM HYPOCHLORITE.

$NaOCl = 74{\cdot}5$.

1. The main test to be applied is the estimation of the active chlorine. For this purpose a definite quantity of the hypochlorite is decomposed with hydrochloric acid, an excess of potassium iodide added to the liquid, and the liberated iodine titrated with N/10 sodium thiosulphate solution in presence of starch paste. The solution of hypochlorite, acidified with hydrochloric acid, may also be estimated volumetrically by means of N/10 arsenious acid solution, starch iodide paper being used as indicator.

SODIUM NITRATE.

$NaNO_3 = 85$.

1. A crystal of the salt, when introduced into a colourless gas flame, should not give a violet coloration, more visible through cobalt glass (potassium nitrate).

2. An aqueous solution (1 : 20) should not alter when treated with hydrogen sulphide (heavy metals), nor give a precipitate with barium chloride (sulphate) or silver nitrate (chlorides), nor when rendered alkaline with ammonia should it give a precipitate with ammonium oxalate (calcium salts).

3. The solution should not become blue when treated with pure potassium iodide and starch paste (sodium nitrite or iodate).

SODIUM NITRITE.

$NaNO_2 = 69.$

The tests to be applied are the same as in the case of potassium nitrite.

SODIUM NITROPRUSSIDE.

$Na_2Fe(NO)\ (CN)_5 + 2H_2O = 298.$

1. An aqueous solution (1 : 50) of the salt, acidified with hydrochloric acid, should not give a turbidity with barium chloride (sulphates).

SODIUM PHOSPHATE (DISODIUM PHOSPHATE).

$Na_2HPO_4 + 12H_2O = 358{\cdot}30.$

1. A crystal should not impart a violet coloration, visible through cobalt glass, to a colourless gas flame (potassium salts).

2. On shaking 1 grm. of the dehydrated powdered salt with 3 c.c. of Bettendorf's reagent, no brown coloration should appear within an hour (arsenic).

3. The aqueous solution should not be changed by hydrogen sulphide (heavy metals), nor, when acidified, should it emit carbon dioxide (sodium carbonate).

4. The aqueous solution, acidified with nitric acid, should not give a turbidity with barium

chloride (sulphates), or with silver nitrate (chlorides).

5. On dissolving 2 grms. of the salt in 10 c.c. of water, acidifying the solution with dilute sulphuric acid, and adding 2 drops of a dilute solution of indigo and 10 c.c. of strong sulphuric acid, the solution should retain its blue colour for a long time (absence of nitrates).

6. Quantitative Estimation.—The acid is estimated gravimetrically by precipitation with magnesia mixture, or volumetrically by titration with uranyl acetate solution (see *Phosphoric Acid*).

SULPHURIC ACID.

$H_2SO_4 = 98{\cdot}08$.

1. On evaporating and igniting 10 grms. of the acid in a platinum dish, no residue should be left (fixed substances).

2. When diluted with 10 volumes of water the acid should not become turbid, nor yield a white precipitate soluble in basic ammonium tartrate solution (absence of lead sulphate).

3. It should not decolorise a few drops of a 0·1 per cent. solution of potassium permanganate, nor give a blue coloration when diluted and treated with a few drops of potassium iodide solution and starch paste (absence of nitrous gases).

4. The dilute acid, when treated with an excess of barium chloride and filtered, should not give a fresh precipitate on the addition of chlorine water (sulphurous anhydride).

5. It should not yield arsenical spots or rings when tested in Marsh's apparatus, nor, when diluted with an equal volume of water, should it give a brown coloration with Bettendorf's reagent (absence of arsenic).

6. It should not, when diluted with water, decolorise a dilute solution of indigo, nor give a red coloration with brucine (nitric acid).

7. It should not give a precipitate with silver nitrate chlorides).

8. On adding to the dilute acid twice its volume of water and half its volume of a saturated solution of sulphur dioxide, it should not give a red coloration (absence of selenious acid).

9. The acid, diluted with 10 volumes of water, should not give a turbidity or precipitate with hydrogen sulphide, nor should it do so after neutralisation with ammonia (absence of heavy metals).

10. Quantitative Estimation.—Sulphuric acid may be estimated gravimetrically as barium sulphate or volumetrically by titration with standard sodium hydroxide solution, with phenolphthalein or methyl orange as indicator.

TARTARIC ACID.

$C_4H_6O_6 = 150{\cdot}05.$

1. Tartaric acid should be colourless, and when ignited on platinum should leave no residue (fixed mineral substances).

2. It should be completely soluble in water and in three times its weight of 90 per cent. alcohol.

3. The solution, nearly neutralised with ammonia, should not give a precipitate or turbidity with hydrogen sulphide (absence of heavy metals).

4. The solution, acidified with nitric acid, should not give a turbidity either with silver nitrate (chlorides) or barium chloride (sulphates), or, after neutralisation with ammonia, with ammonium oxalate (calcium).

5. On adding an equal volume of calcium

sulphate to the solution, which has been nearly neutralised with ammonia, there should be no turbidity (oxalic or racemic acid).

6. On treating the solution with milk of lime in excess, and filtering the liquid, the filtrate should not become turbid when boiled (citric acid).

7. Quantitative Estimation.—This is effected volumetrically by titration with N-potassium or sodium hydroxide solution in presence of phenol phthalein.

TIN CHLORIDE (STANNOUS CHLORIDE).

$$SnCl_2 + 2H_2O = 225.$$

1. The crystals should be colourless, and not of a yellow tint (iron) or milky. They should dissolve in water or alcohol acidified with hydrochloric acid, to form a clear solution.

2. A solution of 1 part of the salt in 50 parts of water containing hydrochloric acid should not become turbid on the addition of barium chloride (sulphates).

3. When heated with potassium hydroxide, it should not emit ammonia (ammoniacal salts).

4. On treating the solution, slightly acidified with hydrochloric acid, with hydrogen sulphide and filtering it from the precipitate, the filtrate should leave no residue on evaporation (salts of zinc, magnesium and alkalies).

5. When 2 grms. of the salt are boiled for some minutes with 10 cc.. of pure concentrated hydrochloric acid, the liquid should remain colourless, and not turn brown or yield a flocculent black deposit (arsenic).

6. Quantitative Estimation.—The tin may be estimated gravimetrically as tin dioxide or metallic tin, or the solution may be titrated with N/10 iodine solution.

URANYL ACETATE.

$UO_2(C_2H_3O_2)_2 + 2H_2O = 424{\cdot}6.$

1. A 5 per cent. aqueous solution of the salt should remain clear after the addition of ammonia and ammonium carbonate in excess (metals of the alkaline earths).

2. A solution of 5 grms of the salt in 5 c.c. of hydrochloric acid, diluted to 100 c.c. should not yield any precipitate when treated with a current of hydrogen sulphide (heavy metals).

3. A solution of the salt (1 : 20) should not give a turbidity with barium chloride (sulphates).

ZINC CHLORIDE.

$ZnCl_2 = 136{\cdot}30.$

1. An aqueous solution of the salt (1 : 20), acidified with hydrochloric acid, should not become turbid with hydrogen sulphide (heavy metals), or with barium chloride (sulphates), and on treating the aqueous solution with hydrogen sulphide the precipitate should be perfectly white, whilst the filtrate should leave no residue when evaporated (calcium, magnesium, alkali salts).

2. The aqueous solution (1 : 20) should give a white precipitate with potassium ferrocyanide, without any sign of red (copper) or blue coloration (iron).

3. On adding to a clear solution of 1 grm. of zinc chloride in 1 c.c. of water, 6 c.c. of 90 per cent. alcohol, a slight flocculent precipitate, which disappears on the addition of a few drops of hydrochloric acid, should gradually be formed (basic zinc chloride).

4. Quantitative Estimation.—The zinc in the

zinc chloride may be estimated gravimetrically as oxide or as sulphide, and also electrolytically.

ZINC SULPHATE.

$ZnSO_4 + 7H_2O = 287{\cdot}55.$

1. An aqueous solution of the salt (1 : 10) should remain clear when treated with ammonia (lead, aluminium, iron), and colourless (copper).

2. The solution should not emit ammonia when boiled (ammonium salts).

3. The solution, acidified with nitric acid, should not become turbid on the addition of silver nitrate (chlorides).

4. On adding a solution of 0·5 grm. of the salt in 1 c.c. of water to 2 c.c. of strong sulphuric acid and 1 c.c. of ferrous sulphate solution a black ring should not be formed at the zone of contact of the two liquids (nitrates).

5. The solution, acidified with hydrochloric acid, should not yield a turbidity or precipitate on treatment with hydrogen sulphide (lead, copper, arsenic).

6. When tested in Marsh's apparatus, it should give a negative result (absence of arsenic).

7. On shaking 2 grms. of the powdered salt with 10 c.c. of absolute alcohol, and filtering the liquid, the filtrate should not turn blue litmus paper red.

8. Quantitative Estimation.—The zinc is estimated gravimetrically as zinc oxide.

REAGENTS AND REACTIONS.

A.

ABELIN (*salvarsan in urine*).—From 7 to 8 c.c. of the urine are acidified in a test-tube with 5 to 6 drops of dilute hydrochloric acid, and, after cooling, the liquid is treated with 3 to 4 drops of 0·5 per cent. sodium nitrate solution. A few drops of this mixture are added to 5 to 6 c.c. of a colourless 10 per cent. solution of resorcinol made alkaline with sodium carbonate. In the presence of salvarsan a pronounced red coloration appears immediately.

ADAMKIEWICZ (*proteins*).—The substance under examination is dissolved in glacial acetic acid, and concentrated sulphuric acid is gradually added to this solution. In the presence of proteins the liquid assumes a violet coloration and becomes slightly fluorescent.

AGOSTINI (*dextrose in urine*).—Five drops of the urine are heated with 5 drops of a 0·5 per cent. solution of gold chloride and 3 drops of a 20 per cent. solution of potassium hydroxide. A red coloration indicates dextrose.

ALESSANDRI-GANASSINI (*nitric acid and nitrates*).—The reagent consists of a saturated solution of phenol in strong hydrochloric acid, and is prepard by heating the two substances for twelve hours on the water-bath. The dry residue from the substance under examination is treated with 10 drops of the reagent and heated on the water-bath. In the presence of nitric acid a violet coloration is obtained. The reaction may be rendered more sensitive by adding to the violet liquid a few drops of ammonia solution, which

immediately produce an intense emerald-green coloration.

ALESSANDRI-GANASSINI (*nitrites*).—On adding a few drops of a mixture of 3 parts of acetic acid with 1 part of phenol to a liquid containing a nitrite, a yellow coloration, which becomes more pronounced after slight heating, is at once obtained. The coloration is much intensified by adding a slight excess of ammonia solution to the liquid. On treating the liquid in a beaker with zinc or aluminium dust and a fragment of potassium hydroxide, it changes first to a greenish tint and finally to blue.

ALFRAISE (*iodine*).—The liquid under examination is treated with 1 drop of a reagent prepared as follows:—To 10 c.c. of starch paste (1 : 100) are added 0·1 grm. of potassium nitrite and 1 drop of hydrochloric acid. In the presence of iodine the well-known blue coloration is obtained.

ALIAMET (*copper salts*).—An addition of 2 per cent. of pyrogallic acid is made to a cold saturated solution of sodium sulphite. This liquid gives an intense blood-red coloration with copper salts.

ALLEN (*stain for bacteriology*).—An addition of 0·1 per cent. of methylene blue is made to a 7·5 per cent. solution of sodium chloride, and the liquid then diluted with 20 c.c. of water.

ALLEN (*phenols*).—Two drops of hydrochloric acid and 1 drop of nitric acid are added to 1 or 2 drops of the liquid under examination. In the presence of phenols, a cherry-red coloration is obtained on heating the liquid.

ALLEN (*vegetable fats*).—Equal volumes of the fat and of nitric acid (sp. gr. 1·40) are shaken for half a minute and allowed to stand for fifteen minutes. In the presence of vegetable fat a coffee-brown coloration is obtained.

ALLEN (*strychnine*).—The ethereal extract of the alkaloid is evaporated by causing it to fall drop by

drop into a basin on the water-bath, and the residue is treated with sulphuric acid and manganese dioxide. In the presence of strychnine a violet coloration is obtained.

ALLEN-GAND (*dextrose*).—A solution of 8·7916 grms. of electrolytic copper in 93 grms. of concentrated sulphuric acid diluted with an equal volume of water is treated with sufficient strong ammonia solution to make the liquid up to a litre. Ten c.c. of this reagent are reduced by 0·050 grm. of dextrose.

ALLEN-FRANKEL (*adrenaline*).—A solution of adrenaline when heated with iodic acid, or with potassium bi-iodate and phosphoric acid gives a red coloration.

ALMEN (*albumin in urine*).—Four grms. of tannin are dissolved in 8 c.c. of 25 per cent. acetic acid and in 190 c.c. of 40 to 50 per cent. alcohol. This reagent also precipitates nucleo-albumin.

ALMEN (*dextrose in urine*).—Four grms. of sodium potassium tartrate are dissolved in 100 grms. of potassium hydroxide solution (sp. gr. 1·33), and about 2 grms. of basic bismuth carbonate are digested in the cold solution, which is then decanted. On heating a liquid containing dextrose with this reagent, it darkens and eventually gives a black precipitate (see *Böttger, Nylander*).

ALPERS (*blood*).—The reagent consists of a mixture in equal volumes of tincture of guaiacum and oil of turpentine. On shaking the reagent with a concentrated solution of blood, the milky liquid turns blue.

ALPERS (*albumin in urine*).—Albumin is precipitated from urine by a 1 per cent. solution of mercuric succinimide.

ALTMANN (*fixative solution*).—This is a mixture in equal parts of a 5 per cent. solution of potassium bichromate and a 2 per cent. solution of osmic acid.

AMAND (*scatol in urine*).—Ten c.c. of the urine are shaken with a drop of sulphuric acid, 2 c.c. of chloroform, and 2 c.c. of a 10 per cent. aqueous solution of sodium persulphate. The chloroform is coloured blue when scatol is present.

ANDERSON (*distinction between the salts of quinoline and of pyridine*).—The double chlorides of pyridine and platinum are converted, when boiled with water, into insoluble double salts, with the liberation of hydrochloric acid, whilst the corresponding salts of quinoline remain soluble.

ANDREASH (*cystine*).—A hydrochloric acid solution of cystine is treated with a few drops of a solution of ferric chloride, and, immediately afterwards, with ammonia. The solution assumes a red colour, which is intensified by shaking the liquid in contact with air.

ANGELI (*hydroxylamine*). The solution of the base or of one of its salts is treated with a few drops of a solution of sodium nitroprusside, and then rendered strongly alkaline with sodium hydroxide and heated. A magenta-red coloration is obtained. The presence of ammonium salts interferes with the reaction.

APERY (*aloes*).—On adding a drop of a dilute solution of ferric chloride to a solution containing aloes (previously decolorised with animal charcoal) a chestnut-brown coloration is obtained. Sensitiveness, 1 : 3,000.

ARATA (*coal-tar colours in wine*). The colouring matters are extracted from the acidified wine by boiling it with wool which has been freed from fat. They are identified by submitting the fibres of the wool to various tests.

ARCHETTI (*caffeine*). A solution of potassium ferrocyanide, when heated to boiling with half its volume of nitric acid, and then diluted with water, gives a precipitate of Prussian blue in the

presence of caffeine. The reaction is also given by uric acid.

ARMANI-BARBONI (*caffeine*).—On boiling for two to three minutes a minute quantity of caffeine with potassium hydroxide solution, cooling the liquid, and adding a small amount of Wellman's reagent (sodium phosphomolybdate) and then a few drops of 50 per cent. potassium hydroxide solution, a brilliant blue coloration resembling that of Fehling's solution is obtained. A similar, though less intense, reaction is obtained with sodium phosphotungstate. The reaction is not given by theobromine.

ARMANI-BARBONI (*nitrates*).—The reagent consists of a saturated solution of benzidine in dilute acetic acid. In the presence of nitrites, an orange-yellow coloration is obtained, which becomes more intense on standing. In applying the test 4 to 5 drops of the reagent are added to 10 c.c. of the liquid under examination.

ARNOLD (*aceto-acetic acid in urine*).—The reagent consists of 2 parts of a solution of 1 grm. of para-amino-aceto-phenone in 80 to 100 c.c. of water with the addition of a few drops of hydrochloric acid to clear the liquid, and of 1 part of a 1 per cent. solution of sodium nitrite. In applying the test equal parts of the reagent and of the urine are treated with 2 to 3 drops of strong ammonia solution, which produces an intense red-brown coloration. On now adding to 1 part of this mixture 10 to 12 volumes of strong hydrochloric acid, there is formed in the presence of aceto-acetic acid a violet-purple coloration and sometimes a yellow coloration.

ARNOLD (*lactic acid in gastric juice*).—The following solutions are used:—(1) An alcoholic solution of 0·1 grm. of gentian violet in 250 c.c. of water; (2) an aqueous solution of ferric chloride (5 : 20). One c.c. of the second solution is mixed with a

few drops of the first, and the filtered gastric juice is added drop by drop to the mixture. If lactic acid is present, a yellowish-green coloration is obtained.

ARNOLD (*alkaloids*).—(1) Certain alkaloids give distinctive colorations when heated on the water-bath with syruppy phosphoric acid (prepared by dissolving metaphosphoric acid and phosphoric anhydride in officinal phosphoric acid), as, for example: aconitine, violet; nicotine, yellow; cocaine, green. (2) Many alkaloids give distinctive colorations when triturated with strong sulphuric acid, and then treated with a 30 to 40 per cent. alcoholic solution of potassium hydroxide.

ARNOLD (*narceine*).—A red coloration is obtained on heating narceine with strong sulphuric acid and a trace of phenol.

ARNOLD-VITALI (*alkaloids*). A small quantity of the alkaloid is ground up with strong sulphuric acid, a crystal of sodium nitrite added, and subsequently some alcoholic potassium hydroxide solution (30 to 40 per cent.). Many alkaloids give distinctive colorations. For example, atropine and homatropine give an orange-yellow coloration, which, on the addition of potassium hydroxide, changes to reddish-violet and finally to pink.

ARNOLD-WERNER (*phenol*). A solution of phenol, when rendered slightly alkaline with ammonia, and boiled with bromine, gives a blue coloration. Under the same conditions *m*-cresol gives a bluish green coloration, *p*-cresol no coloration, and *o*-cresol a blue coloration.

ARZNBERGER (*essential oil of peppermint*).—On heating 1 drop of this essential oil with 1 c.c. of formaldehyde a pink coloration is obtained; this does not appear with menthol, nor with the oil of other varieties of mint. When the liquid is

treated with glacial acetic acid, the colour becomes red, then violet, and finally brown.

AYMONIER (*α-naphthol*).—A 15 per cent. alcoholic solution of α-naphthol gives a violet-coloration when mixed with sugar and twice its volume of sulphuric acid. On treating the alcoholic solution of α-naphthol with 1 drop of a mixture of 1 part of potassium bichromate, 10 parts of water, and 1 part of nitric acid, a black precipitate is obtained. This reaction is not given by β-naphthol.

B.

BACH (*hydrogen peroxide*).—Two solutions are prepared, the first containing 0·03 grm. of potassium bichromate and 5 drops of aniline in a litre of water; the second 5 grms. of oxalic acid in 100 c.c. of water. On shaking 5 c.c. of hydrogen peroxide with 5 c.c. of the first solution and 1 drop of the second, a reddish-violet coloration is obtained. Sensitiveness 1 : 400,000.

BACH (*copper salts*).—The reagent consists of a mixture in equimolecular parts of 20 per cent. formaldehyde and hydroxylamine hydrochloride. In the presence of a trace of copper salts, previously treated with potassium hydroxide, it gives a violet coloration.

BAECCHI (*blood*).—An aqueous solution of alizarine blue S is diluted with water until it appears of a yellow colour. Two c.c. of this solution are shaken with 1 c.c. of hydrogen peroxide, and the liquid to be tested is poured down the side of the test-tube. In the presence of blood, an intense blue coloration will be produced in the upper part of the tube.

BAEME (*tannin*).—A solution containing 1 grm. of sodium tungstate and 2 grms. of sodium acetate

in 10 c.c. gives an insoluble yellow precipitate with tannin in acid or alkaline solution.

BAEYER (*dextrose*).—On boiling a solution of dextrose with orthonitrophenylpropionic acid and sodium hydroxide, a blue coloration (due to the formation of indigo) is obtained.

BAEYER (*indol*).—An aqueous solution of indol gives a red coloration, and then a red precipitate, on treatment with fuming nitric acid.

BARBOT (*fatty oils*).—On treating 200 grms. of the oil with 2 grms. of fuming nitric acid saturated with oxides of nitrogen, the mixture assumes various colours, according to the nature of the oil. In the case of olive oil, the mixture is white, and, after an hour, a solid product separates.

BARFOED (*dextrose*).—A solution of 14 grms. of crystalline copper acetate in 200 c.c. of water and 5 c.c. acetic acid is reduced by dextrose at the ordinary temperature, and more rapidly on heating. Dextrin, lactose, and cane sugar do not give this reaction.

BARRALET (*hydrogen peroxide*).—On adding hydrogen peroxide to a mixture of potassium ferrocyanide and a ferrous salt, Prussian blue is obtained.

BASCH (*sesamé oil in olive oil*).—One c.c. of the oil is dissolved in 1 c.c. of petroleum spirit, and the solution treated with an equal volume of sulphuric acid containing a third of its volume of hydrogen peroxide (the mixture must have been made in the cold). The tube is shaken two or three times and allowed to stand. In the presence of sesamé oil, a green ring appears at the zone of contact of the two liquids, the petroleum spirit layer being coloured brown.

BAUDOUIN (*sesamé oil*).—On shaking 2 parts of the oil with 1 part of a solution of 1 grm. of cane sugar in 10 c.c. of hydrochloric acid (sp. gr. 1·18)

a pink coloration is obtained in the presence of sesamé oil.

BAUER (*solanine*).—A solution of telluric acid in sulphuric acid gives a red coloration when heated with a faint trace of solanine.

BAUMANN-GOLDMANN (*cystine*).—A sodium hydroxide solution of cystine gives a voluminous precipitate when shaken with benzoyl chloride.

BECHI (*cotton seed oil*).—(*a*) A solution of 1 grm. of silver nitrate in 5 c.c. of water is diluted to 200 c.c. with 96 per cent. alcohol; (*b*) 85 grms. of amyl alcohol are mixed with 15 grms of colza oil. Ten c.c. of the oil under examination are shaken with 1 c.c. of the solution (*a*) and then with 10 c.c. of solution (*b*), and the mixture heated for ten minutes on the water-bath. A brown coloration is produced in the presence of cotton seed oil.

BEHRENS (*fatty oils*).—On shaking an oil with equal volumes of strong sulphuric and nitric acids solidification may take place, and various colorations are obtained, according to the nature of the oil.

BEISSENHIRTZ (*aniline*).—A solution of aniline in strong sulphuric acid gives first a red and then a blue coloration on treatment with potassium bichromate.

BELA VON BITTÒ (*aldehydes and ketones*).—A few c.c. of a 0·5 to 1 per cent. aqueous or alcoholic solution of a salt of metadiamine are added to the solution under examination. In the presence of aldehydes or ketones, there will be produced, after a few minutes, a magnificent green fluorescence, which disappears on rendering the liquid alkaline and reappears on acidification.

BELLIER (*sesamé oil*).—(1) When sesamé oil is shaken with a solution of 2 grms. of sodium vanadate in 100 c.c. of sulphuric acid and 50 c.c. of water an intense green coloration, changing

to black, is obtained. (2) On shaking a mixture of 100 c.c. of sulphuric acid, 50 c.c. of water, and 100 c.c. of a 40 per cent. solution of formaldehyde with an equal volume of the oil, an emulsion of a pronounced blue-black colour is produced. (3) Two c.c. of the oil are shaken with 2 c.c. of crystallised benzene saturated with resorcinol and 2 c.c. of nitric acid (sp. gr. 1·38) free from nitrous fumes, and the appearance of the upper oily layer and the lower acid layer is noted. In the presence of sesamé oil, the mixture becomes intense blue, whilst the acid which separates assumes an intense bluish-green coloration, which is not very permanent, although it persists for at least five minutes.

BERLINERBLAU (*dulcine*).—A small quantity of the substance is mixed with 2 to 3 drops of pure phenol and an equal quantity of strong sulphuric acid, and the mixture is heated for some time at the boiling temperature. After cooling, the liquid is diluted and cautiously treated with sodium hydroxide solution so as to form two layers. At the zone of contact there is formed a blue ring, which becomes more intense, and gradually extends to the alkaline liquid.

BERTHELOT (*phenol*).—On adding a small quantity of a solution of sodium or calcium hypochlorite to the liquid, which has been made slightly alkaline, and heating the mixture, a blue coloration, changing to red on acidification, is obtained when phenol is present.

BERTRAND (*alkaloids*).—Silicotungstic acid (5 per cent. solution of sodium silicotungstate) gives with solutions of alkaloids, in presence of hydrochloric acid, precipitates, which are flocculent, gelatinous, powdery or crystalline, and of various colours, according to the nature of the alkaloid.

BERZELIUS (*proteins*).—A recently-prepared con-

centrated solution of metaphosphoric acid precipitates all the proteins from their aqueous solutions.

BEST (*glycogen*).—A solution of 1 grm. of carmine with 2 grms. of ammonium chloride and 0·5 grm. of lithium carbonate in 50 c.c. of water gives a coloration at the zone of contact.

BETTENDORF (*arsenic*).—A solution of stannous chloride saturated with gaseous hydrochloric acid produces in the hot liquid under examination a brown coloration or a black precipitate of metallic arsenic, provided that no oxidising substances are present.

BIAL (*pentoses in urine*).—A solution of 1·5 grm. of orcinol in 500 c.c. of hydrochloric acid (30 per cent.) is treated with a few drops of a 10 per cent. solution of ferric chloride. On heating to boiling point a small quantity of the urine with 5 drops of this reagent, a green coloration indicates pentoses.

BIEBER (*almond oil*).—Five parts of the oil are shaken, in the cold, with 1 part of a mixture in equal proportions of sulphuric acid (*puriss.*, of 66° Be.) and fuming nitric acid (sp. gr. 1·42). Pure almond oil forms a yellowish emulsion, changing after some time to red, whilst peach-kernel oil forms a fugitive purple emulsion, which soon changes to orange, and then to brown.

BIEL (*cocaine*).—A solution of 0·1 grm. of cocaine hydrochloride in 1 c.c. of strong sulphuric acid is heated for some minutes on the water-bath, and 99 c.c. of water then added. Under these conditions, benzoic acid is precipitated as a white crystalline mass.

BIFFI (*biliary pigments*).—The urine (100 c.c.) is acidified with sulphuric acid, and then treated, little by little, with 30 drops of a 5 per cent. solution of barium chloride. The liquid is

decanted while still turbid, and immediately poured on to dry absorbent cotton on a sheet of glass, and in the middle of this is placed a crystal of potassium bichromate. If the urine contains biliary pigments, even in small quantity, a green ring will appear and gradually spread, whilst in the vicinity of the crystal a blue ring, changing to red, will be formed.

Bischoff (*biliary acids*).—Biliary acids give a red coloration when heated with dilute sulphuric acid and cane sugar.

Bishop (*sesamé oil*).—On shaking equal volumes of hydrochloric acid and sesamé oil which has been exposed to the light for twenty-four hours the acid, which separates after standing, gradually assumes a bluish-green coloration.

Blarez (*coal-tar colours in wine*).—Twenty c.c. of the wine are shaken for a minute with 5 grms. of lead peroxide and filtered. Natural colouring matters of the wine disappear, whilst coal-tar colours remain.

Boas (*hydrochloric acid in gastric juice*).—The reagent consists of a solution of 1 grm. of resorcinol and 3 grms. of sugar in 100 c.c. of 50 per cent. alcohol. The liquid to be tested is mixed with a few drops of the reagent and evaporated. In the presence of hydrochloric acid a red coloration will be obtained.

Boas (*lactic acid in gastric juice*).—The test depends on the oxidation of the lactic acid to aldehydes and formic acid by regulated treatment with maganese dioxide and sulphuric acid. The aldehydes are recognised by the formation of iodoform by means of an alkaline solution of iodine, or by the reaction obtained with Nessler's reagent. This reaction is more distinctive than that of Uffellmann.

Bocchi (*filicic acid*).—On treating a hot solution of filicic acid in dilute ammonium hydroxide

with hydrochloric acid, then making the liquid alkaline again with ammonia, and adding a trace of a solution of ferrous and ferric chlorides, a fine violet coloration is produced.

BODDE (*differentiation of resorcinol from phenol, benzoic acid, and salicylic acid*).—A solution of resorcinol gives with sodium hypochlorite a violet coloration, changing to yellow; on the addition of more hypochlorite, or on heating, a yellowish-rose coloration, changing to brown, is obtained. By adding ammonia before the hypochlorite there is produced first a violet and then a yellow coloration, which on heating changes to dark green. Phenol and benzoic and salicylic acids give only a slight yellow coloration with sodium hypochlorite, and that only on heating; on the addition of ammonia the acids give no coloration, whilst phenol gives a greenish-blue coloration.

BÖDECKER (*albumin in urine*).—A solution of potassium ferrocyanide, added to a liquid containing albumin and acidified with acetic acid, gives a turbidity or a flocculent precipitate.

BÖHMER (*stain for microscopy*).—(1) Hæmatoxylin, 1 grm. in 10 c.c. of absolute alcohol; (2) ammonium alum 10 grms. in 200 c.c. of water. The two solutions are mixed and filtered after a week.

BONNEMA (*vanillin*).—A trace of vanillin is dissolved in a few c.c. of acetic acid containing 10 per cent. of hydrochloric acid, and the solution is treated with 5 drops of essential oil of santal-wood. A cherry-red coloration is obtained, which becomes violet brown on heating, and changes to green after twenty-four hours.

BÖRNSTEIN (*saccharin*).—The saccharin is extracted with ether, the ethereal solution evaporated, and the residue heated with resorcinol and strong sulphuric acid. The fused mass is washed

with water and rendered alkaline with potassium hydroxide. Fluorescein produced from the saccharin causes the liquid to have an intense yellowish-green fluorescence.

BORNTRÄGER (*aloes*).—An alcoholic solution of the aloes is shaken with petroleum spirit, and the extract separated and shaken, with gentle warming, with a few drops of strong ammonia solution. A violet coloration is produced in the liquid. This reaction is also given by rhubarb, turmeric, and catechu.

BÖTTGER (*nitrous acid*).—A solution of 1 grm. of starch in 200 c.c. of water and 1 grm of hydrochloric acid is neutralised with calcium carbonate, then treated with 10 grms of sodium chloride and 0·5 grm. of cadmium iodide, and diluted to 250 c.c. In the presence of nitrous acid a blue coloration is obtained.

BÖTTGER (*hydrogen peroxide*).—The reaction is based upon the reducing action of hydrogen peroxide upon ammoniacal silver oxide.

BÖTTGER (*animal and vegetable fibres*).—The fibres under examination are dyed with an alcoholic solution of rosolic acid, and extracted with sodium hydroxide solution and washed. Animal fibres then show a rose colour, and linen red, whilst cotton remains unaltered. Or the fibres may be dyed with magenta, and washed with water and extracted with ammonia solution. Only cotton fibres retain the colour under these conditions.

BÖTTGER (*dextrose in urine*).—On boiling a solution containing dextrose with a solution of sodium carbonate and a little bismuth subnitrate, a dark coloration and then a black precipitate is obtained.

BÖTTGER (*colouring matters in wine*).—The wine is diluted with nine times its volume of water, and then treated with a third of its volume of

a concentrated solution of copper sulphate. Pure wine is decolorised, whilst added colouring matters, such as mallow, cherry and magenta remain unaltered, or are changed to violet.

BÖTTGER (*sugar in glycerin*).—A mixture of 5 drops of the glycerin, 5 c.c. of water, 1 drop of nitric acid, and 0·03 grm. of ammonium molybdate is heated to boiling. If sugar is present an intense blue coloration will be produced.

BOUCHARDAT (*alkaloids*).—A solution of 2 grms. of iodine and 4 grms. of potassium iodide in 100 c.c. of water gives brown precipitates with alkaloids.

BOUDET (*olive oil*).—Olive oil (20 parts) is solidified by treatment with 1 part of fuming nitric acid containing a little cane sugar or starch or copper (*elaidin test*).

BOUGAULT (*antipyrin*).—Antipyrin in alcholic solution absorbs iodine when treated with a solution of mercuric chloride (2·5 per cent.) and then with iodine solution (1·351 per cent.). One c.c. of the iodine solution corresponds with 0·01 grm. of antipyrin (*volumetric method*).

BOUSSINGAULT (*nitric acid*).—A little hydrochloric acid is boiled in a test-tube, and a few drops of a dilute sulphuric acid solution of indigo, and then the solution under examination are added. In the presence of nitric acid the indigo is bleached.

BRAND (*quinine and quinidine*).—On mixing these alkaloids with chlorine water a brilliant emerald-green coloration is produced (thalleioquin reaction). Cinchonine and cinchonidine do not give this reaction.

BRAND (*abrastol in wine*).—After removal of the colouring matter of the wine by means of lead dioxide and sulphuric acid the wine is extracted with chloroform, and the extract evaporated.

Abrastol may be detected in the residue by the green coloration which it gives with sulphuric acid.

Brandes (*creosote*).– On treating 1 c.c. of creosote with 10 c.c. of 20 per cent. alcoholic potassium hydroxide solution a compact crystalline mass is obtained.

Braun (*nitric acid*).—On adding to the solution of a nitrate a little aniline sulphate and then strong sulphuric acid a bluish-violet coloration is obtained.

Braun (*dextrose*).—A red coloration is produced when a solution of dextrose is heated with a few drops of a solution of picric acid (1 : 250).

Braütigam-Edelmann (*horseflesh*).—The broth prepared from the flesh is freed from proteins and tested with a potassium solution of iodine. In the presence of horseflesh, which contains glycogen, a Bordeaux-red coloration is produced.

Bremer (*dextrose in blood*).—Equal volumes of a saturated solution of eosin and of methylene blue are mixed, and the resulting precipitate washed, dried, and powdered. To this powder is added an additional one twenty-fourth of eosin and one fourth of methylene blue. A glass coated with the preparation of the blood is immersed in a solution of 0·05 grm. of this powder in 10 c.c. of 35 per cent. alcohol. The presence of dextrose is indicated by a blue-black coloration.

Bremer (*sesamé oil in margarine*).—Ten drops of furfural are added to a cold mixture of 50 c.c. of strong sulphuric acid and 50 c.c. of alcohol. A drop of this reagent brought in contract with margarine containing sesamé oil produces, after a few minutes, a cherry-red coloration.

Brissemoret-Derrien (*digitalis glucosides*).—A solution of the glucosides in 30 c.c. of a 4 per cent. solution of oxalic acid, previously treated

with sodium amalgam, when poured on to strong sulphuric acid and allowed to stand, gives a green coloration in the presence of digitoxine, and a cherry-red zone in the presence of amorphous digitaline.

BROUARDEL-BOUTMY (*ptomaines and vegetable alkaloids*).—Ptomaines, when treated with a mixture of potassium ferricyanide and ferric chloride, give Prussian blue. This reaction, however, does not always take place.

BRÜCKE (*proteins*).—Coagulated albumin gives a violet coloration when suddenly treated with a dilute solution of copper sulphate, and then, after removal of the excess of liquid, with dilute sodium hydroxide solution (biuret reaction).

BRÜCKE (*dextrose*).—The reagent is prepared by boiling 5·5 grms. of recently-precipitated basic bismuth nitrate in a solution of 30 grms. of potassium iodide in 150 c.c. of water, and adding, after five minutes, 5 grms. of 25 per cent. hydrochloric acid. In the presence of dextrose this reagent gives a black coloration.

BRUILÉ (*olive oil*).—Ten c.c. of the oil are boiled with 0·1 grm. of powdered albumin and 25 c.c. of nitric acid. After the albumin has dissolved the oil (if pure olive oil) becomes practically colourless, and when cold is pale yellow and turbid, and, after twenty-four hours, solidifies to a solid yellow mass. The presence of cotton-seed oil causes the initial yellow coloration to continue to orange and brownish-red, whilst, as a rule, solidification does not take place.

BRUNNER (*alkaloids*).—The reagents suggested by Brunner for the identification of alkaloids include the following :—

(1) The alkaloid is carefully heated with a crystal of chloral hydrate and 15 drops of sulphuric acid. Morphine, codeine, and apomorphine give a grass-green coloration ; narcotine,

first a green and then a brown and red coloration; papaverine, violet, changing to rose colour when heated; colchicine, veratrine, and picrotoxine, a red coloration. Bromal hydrate under the same conditions gives analogous colorations with morphine, narcotine, narceine, and papaverine.

(2) On adding to the alkaloid a drop of paraldehyde and 5 drops of sulphuric acid, morphine and codeine give an orange coloration; apomorphine, a violet coloration; papaverine, reddish-yellow and then red; solanine orange; and picrotoxine, a yellow coloration changing to red on heating.

(3) When the alkaloid is treated with 4 to 5 drops of a recently-prepared solution of 2 drops of furfural in 10 c.c. of strong sulphuric acid the following colorations are produced: — Morphine, bright red, changing on heating to olive green; codeine and apomorphine, red; narcotine and narceine, as with chloral hydrate; papaverine, violet on heating; solanine, yellowish-brown; veratrine, first yellow and then green: picrotoxine, first yellow and then reddish-brown.

(4) The alkaloid is treated with 4 to 5 drops of a solution of 1 grm. of orthonitrophenylpropiolic acid in 100 c.c. of sulphuric acid, and the following colorations are obtained: - Morphine, codeine and apomorphine, violet on heating; papaverine, violet in the cold, reddish on heating; solanine, yellow; picrotoxine, red and then olive-green. Narcotine and narceine give the same colour reactions as with chloral hydrate.

BRUYLANTS (*morphine*).—(1) On adding a few drops of an aqueous solution of iodic acid to a sulphuric acid solution of morphine, previously heated, a lilac or rose coloration is produced.

(2) When a drop of a solution of morphine in

strong sulphuric acid is heated on a porcelain tile and treated with a drop of Fröhde's reagent a green coloration is produced.

BUCKINGHAM (*alkaloids*).—The reagent consists of a recently-prepared solution of 1 grm. of ammonium molybdate in 16 grms. of sulphuric acid, which has been heated until the liquid is clear. This reagent gives precipitates of various colours with many alkaloids.

BUYWID (*nitrous acid*).—From 70 to 80 c.c. of the liquid under examination are heated with a few drops of hydrochloric acid, and a few drops of a 0·01 to 0·02 per cent. alcoholic solution of indol are added. In the presence of nitrites there appears, after a few minutes, a red coloration, which augments in intensity.

C.

CAILLETET (*tartaric acid in citric acid*).—A crystal of citric acid is treated with a saturated solution of potassium bichromate. Pure citric acid slowly forms a brown zone, but if tartaric acid is present a dark violet coloration is obtained.

CAILLETET (*oils*).—The reagent consists of a mixture of 12 parts of phosphoric acid (sp. gr. 1·84) with 10 parts of nitric acid (sp. gr. 1·37). The oils are shaken with this mixture, and from their changes in colour and consistence conclusions are drawn as to their purity. Olive oil gives a bluish-green coloration, and the presence of other oils affects this coloration.

CAILLETET (*copper in oils*).—Ten c.c. of the oil are shaken with 5 c.c. of a 2 per cent. ethereal solution of pyrogallic acid. In the presence of copper the mixture assumes a brown colour, owing to the separation of copper pyrogallate.

CAMOIN (*sesamé oil*) —A red coloration is obtained

on shaking two volumes of the oil with one volume of hydrochloric acid containing 2 per cent. of sugar (*cf.* Baudouin, Villavecchia and Fabris).

Campani (*dextrose in urine*).—The reagent consists of a concentrated solution of lead acetate mixed with a dilute solution of copper acetate. This solution is reduced by dextrose, but not by cane sugar.

Campbell-Starch (*tartaric acid in citric acid*).—One c.c. of a 10 per cent. solution of ammonium molybdate is added to 1 grm. of the citric acid under examination. If a blue coloration appears the liquid is heated until it disappears. When cold, 5 c.c. of a 25 per cent. solution of hydrogen peroxide are added, and an intense yellow coloration should then be obtained.

Capranica (*guanine*).—A hot solution of guanine hydrochloride gives a yellow precipitate when treated with a saturated solution of picric acid; with potassium chromate in concentrated solution a crystalline reddish orange precipitate; and with potassium ferrocyanide solution a brownish-yellow precipitate.

Capranica (*biliary pigments*).—The urine under examination is treated with a little bromine water, and the mixture shaken with alcohol and ether (1 : 1). In the presence of biliary pigments there is obtained a green coloration changing to indigo-blue, then to violet, and finally to yellowish-red. On adding hydrochloric acid and shaking the mixture, the acid layer becomes coloured as described.

Carey-Lea (*hydrocyanic acid*).—The reagent consists of a solution of 1 grm. of ferrous ammonium sulphate and 1 grm. of uranium nitrate in 250 c.c. of water. In the presence of hydrocyanic acid or its salts an intense reddish-purple coloration and precipitate is obtained

CARNOT (*potassium salts*).—On treating 1 drop of a N/2 solution of bismuth nitrate with 2 to 3 drops of a N/2 solution of sodium thiosulphate, then with 10 to 15 c.c. of absolute alcohol, and finally adding a small quantity of a potassium salt, a yellow precipitate of bismuth potassium thiosulphate is obtained.

CARO (*persulphates*).—When a solution of a persulphate is added to a neutral 2 per cent. solution of aniline, and the liquid is heated for a few minutes, a brownish-orange precipitate is immediately obtained. In very dilute solutions, however, only a brown coloration appears. When the precipitate is treated with hot benzene a product is obtained which dissolves in hydrochloric acid, forming a yellow solution, changing to violet on heating.

CARO (*alkaloids*).—The reagent consists of strong sulphuric acid and ammonium persulphate. It gives an orange coloration with brucine, blood-red with thebaine, red-brown with narcotine, and yellow with quinine.

CARO-FISCHER (*hydrogen sulphide*).—The solution is treated with one-fiftieth of its volume of strong hydrochloric acid, a crystal of *p*-aminodimethylaniline sulphate dissolved in the liquid, and 2 drops of ferric chloride solution then added. In the presence of hydrogen sulphide a blue coloration (methylene blue) is obtained.

CARO-FISCHER (*cobalt*).—On mixing equal volumes of a concentrated solution of sodium bicarbonate and hydrogen peroxide a green coloration is immediately obtained in the presence of a trace of cobalt.

CARO-FISCHER (*chromates, bichromates*). — On shaking hydrogen peroxide and ether with a very dilute solution of a chromate or bichromate, in the presence of sulphuric acid, the ether is coloured bright blue.

CARPENÉ (*tannins in wine*).—A saturated solution of zinc acetate in 5 per cent. ammonia solution gives a precipitate in liquids containing tannin, but does not precipitate gallic acid.

CARREZ (*antipyrin*).—The substance under examination (0·01 grm.) is mixed with 0·01 grm. of quinine sulphate, and dissolved in 25 c.c. of 90 per cent. alcohol. One c.c. of this solution is evaporated to dryness in a crucible, and a few drops of 0·3 per cent. bromine water, followed by a few drops of ammonia solution, are made to fall on to the residue. The appearance of a red-violet coloration indicates the presence of antipyrin. Sensitiveness = 0·1 mgrm.

CARREZ (*albumin in urine*).—One grm. of resorcinol is dissolved in 2 c.c. of water, and a few c.c. of the urine are added to the solution, so as not to mix the two liquids. At the zone of contact a white ring is formed. Urates, urea, and alkaloids do not give this reaction, whilst peptone forms a ring which disappears on heating.

CAZENEUVE (*coal-tar dyes in wine*).—Pure wine, when shaken with yellow mercuric oxide, yields a colourless filtrate, whilst a coloured filtrate indicates the presence of coal-tar dyestuffs.

CENCI (*salicylic acid*).—On adding a few drops of a solution of 5 grms of zinc in 30 c.c. of nitric acid to a hot solution containing salicylic acid or a salicylate there is produced a violet coloration, which on boiling changes to bright red. Sensitiveness = 1 : 60,000.

CHAPMAN (*eugenol and isoeugenol*).—One c.c. of eugenol or isoeugenol is dissolved in 5 c.c. of acetic anhydride and the solution treated with a drop of sulphuric acid and a fragment of pure zinc. In the presence of eugenol the addition of sulphuric acid causes a purple-red or claret-red coloration to appear, and zinc chloride gives a pale yellow coloration to the mixture. Iso-

eugenol, however, gives a rose coloration, changing to light brown with sulphuric acid, whilst zinc chloride produces a red coloration.

CHAPMAN (*safrol and isosafrol*).—A solution of 1 c.c. of safrol in 5 c.c. of acetic anyhdride gives, when treated with a drop of strong sulphuric acid, an emerald-green coloration, changing to brown, whilst with zinc chloride the mixture is coloured first pale blue and then light brown. Isosafrol under the same conditions gives with strong sulphuric acid a rose coloration, changing to red ; with zinc chloride it immediately gives a rose coloration, changing to brown.

CHAPMAN-SMITH (*tartaric acid in citric acid*).—A strongly alkaline boiling solution of permanganate gives a green coloration with citric acid, whilst, in the presence of tartaric acid, it is decomposed, with the separation of manganese dioxide.

CHASTAING-RABILLOT (*morphine*).—The substance under examination is mixed with 0·5 grm. of oxalic acid, and then with 1 c.c. of sulphuric acid and heated for an hour in an oil-bath at 120° to 125° C. After cooling, 3 to 4 c.c. of water are added, and sufficient alcoholic sodium hydroxide solution (4 to 5 c.c. of 36°) to render the liquid strongly alkaline. The mixture is left for twelve hours exposed to the air or to an atmosphere of oxygen. It is then acidified with 20 per cent. hydrochloric acid, and under such conditions the mixture, in the presence of morphine, soon assumes a blue or bluish-green colour. The liquid is extracted with chloroform, which becomes of a blue colour, and on spontaneous evaporation deposits blue crystals of morphine.

CHAUTARD (*acetone in urine*).—The reagent consists of a solution of magenta in sulphurous acid ; when added to urine containing acetone it produces a violet coloration.

CHRISTEL (*picric acid*).—(1) On adding ammoniacal lead acetate solution to an aqueous solution of picric acid a rose-coloured precipitate is obtained, whilst copper sulphate forms a green precipitate.

(2) An aqueous solution of methyl green gives with picric acid a green precipitate, which dissolves in a large volume of water to form a green solution.

(3) An alkaline solution of stannous chloride, as also ammonium sulphide, gives a red coloration with picric acid.

(4) When picric acid is treated with zinc and dilute sulphuric acid a turbid yellowish-red solution is obtained. On mixing this solution with a large amount of alcohol, and filtering the mixture, after a short time there is produced a green coloration, changing to violet and then to reddish-violet.

CHRISTENSEN (*albumin in urine*).—A dilute solution of tannin gives a precipitate when added to a solution containing albumin.

CIAMICIAN-MAGNANINI (*scatol*).—A reddish-purple coloration is obtained on heating scatol with sulphuric acid.

CLARUS (*solanine*).—Solanine gives a bright blue coloration when treated with a solution of chromic acid.

COHEN (*albumin*).—Albumin gives a turbidity or precipitate when treated with a 50 per cent. acetic acid solution of 1 grm. of iodine and 1 grm. of potassium iodide.

COHN-MEHRING (*hydrochloric acid in gastric juice*).—On adding cinchonine to gastric juice cinchonine hydrochloride is formed, and may be quantitatively estimated.

COLASANTI (*thiocyanic acid in saliva*).—The saliva is treated with alcohol and filtered, the filtrate evaporated on the water-bath, the residue

dissolved in water, and the solution treated with copper sulphate. Thiocyanic acid in saliva gives an emerald-green coloration.

COLASANTI (*thiocyanates and essential oil of mustard*).—A very dilute solution is treated with a 20 per cent. solution of α-naphthol, and then, without shaking, with twice its volume of strong sulphuric acid. In the presence of thiocyanates or mustard oil an emerald green ring is produced at the zone of contact. On shaking the mixture, the liquid assumes a violet colour.

CONRADY (*cane sugar in lactose*).—A solution of 1 grm. of cane sugar in 10 c.c. of water is boiled for five minutes with 0·1 grm. of resorcinol and 1 c.c. of hydrochloric acid. In the presence of cane sugar, or dextrose and lævulose, the mixture assumes a red colour.

CONROY (*cotton oil in olive oil*).—A mixture of 9 parts of oil with 1 part of nitric acid (sp. gr. 1·40) remains fluid when cold, and assumes a reddish-orange colour when cotton oil is present. Pure olive oil under the same conditions forms a solid yellow mass.

CONTEJEAN (*free hydrochloric acid in gastric juice*).—When freshly-precipitated cobalt carbonate is dissolved in the liquid under examination, it gives a red coloration, changing to blue on evaporation.

CORNETTE (*resin oils in vegetable oils*).—The test is based upon the fact that sodium resinates are soluble in a saturated solution of sodium chloride, whilst the sodium salts of the higher fatty acids are insoluble therein.

COTTINI-FANTOGINI (*artificial colours in wine*).—Fifty c.c. of the wine are heated with 6 c.c. of strong nitric acid. The natural colour of wine does not alter after an hour, whereas wine that has been artificially coloured is decolorised within five minutes.

COTTON (*phenol*).—An aqueous solution of phenol turns yellow when treated with sulphuric acid and a nitrate, and brown when treated with ammonia, and on the subsequent addition of bromine water gives a green coloration which changes to intense blue on heating.

CRACE-CALVERT (*sesamé oil in olive oil*).—Olive oil containing sesamé oil gives a greenish coloration when shaken with one-fifth of its volume of nitro-sulphuric acid (equal parts of sulphuric acid of sp. gr. 1·84, and nitric acid of sp. gr. 1·33).

CRINON (*phenacetin*).—Chlorine water or a solution of calcium hypochlorite gives a reddish-violet coloration with phenacetin.

CRIPP-DYMONT (*aloes*).—A mixture of 0·05 grm. of the substance with 15 drops of sulphuric acid is treated with 4 drops of nitric acid (sp. gr. 1·42), and then with 30 c.c. of water. In the presence of aloes the solution gives a red-orange coloration, which changes to carmine-red, and, on the addition of ammonia, to blood-red.

CRISMER (*tartaric acid in citric acid*). The acid to be tested is powdered and heated for a few minutes on the water-bath with a solution of ammonium molybdate and a few drops of hydrogen peroxide. In the presence of tartaric acid a blue coloration is obtained, whilst citric acid gives only a yellow coloration. Sensitiveness = 1 : 1,000.

CRISMER (*aldehydes*). The reagent consists of a solution of potassium iodide and mercuric chloride which has been treated with potassium hydroxide or baryta water. It gives a coloured precipitate with aldehydes.

CRISMER (*dextrose in urine*). The reagent is prepared by treating 0·1 grm. of safranine in 100 cc. of water with 40 c.c. of potassium hydroxide solution. One c.c. of the urine is heated with

7 c.c. of the reagent, and if dextrose be present the liquid is decolorised.

CRISWELL (*dextrose in urine*).—The reagent consists of 35 grms. of copper sulphate, 100 c.c. of water, 200 grms. of glycerin, and 450 c.c. of 20 per cent. sodium hydroxide solution. It is heated for fifteen minutes, and then cooled and diluted to 1 litre.

CROKER (*stain for microscopy*).—A solution of 1 grm. of powdered cochineal, 18 grms. of alum, and 100 c.c. of water is evaporated to half its volume, filtered, and treated with 0·5 c.c. of liquid phenol.

CROLAS-DUCKER (*uranium salts*).—Tincture of cochineal is changed to green when treated with alum in the presence of uranium salts.

CROUZEL (*animal fats in vaseline*).—A solution of potassium permanganate is decomposed by animal and vegetable fats, with the separation of manganese dioxide, but is not affected by vaseline.

CROUZEL (*santonine in urine*).—Urine containing santonine gives a carmine-red coloration when treated with freshly-prepared lime (*e.g.*, from calcium carbide).

CRUMS (*manganese salts*).—Manganese salts, when heated with lead dioxide and 1 c.c. of strong nitric acid and then diluted with water, give a solution of an intense violet colour, due to the formation of permanganic acid. Chlorides interfere with the reaction.

CUERBE (*narcotine*).—On heating a solution of narcotine in concentrated sulphuric acid, which has stood for one or two hours, with a little nitric acid, a bright red coloration is obtained.

CUNISSET (*biliary pigments*).—Chloroform assumes a yellow colour when shaken with urine containing biliary pigments.

CURTMANN (*nitric acid*).—A solution of pyrogallic

acid in sulphuric acid gives a yellow coloration with nitric acid in the proportion of as little as 1 : 500,000.

CURTMANN (*nitrous acid*).—Antipyrin gives a green coloration with nitrous acid.

CURTMANN (*ammonia and hydrogen sulphide*).—On treating a solution of chloral hydrate with ammonia, and then with hydrogen sulphide, a reddish-brown coloration or precipitate is obtained. Conversely, a solution of chloral hydrate containing hydrogen sulphide is coloured yellow on the addition of a little ammonia.

CUTOLA (*cellulose*).—Cellulose is coloured blue by a 50 per cent. solution of hydriodic acid containing iodine.

CZAPLEWSKI (*stain for bacteriology*).—One grm. of magenta is ground up with 5 c.c. of liquid phenol, and then mixed with 50 c.c. of glycerin and 100 c.c. of water. For use as a stain, the liquid is diluted with 4 to 5 volumes of water.

CZERNIEWSKI (*aspidospermin*).—Aspidospermin, when heated with dilute sulphuric acid and a trace of potassium chlorate, gives a red coloration, which after a short time becomes permanent.

CZOKOR (*stain for microscopy*).—A solution of phenol is treated with 1 grm. of carmine and alum in 100 c.c. of water.

CZUMPELITZ (*alkaloids*).—The reagent consists of a solution of fused zinc chloride in 30 c.c. of strong hydrochloric acid and water. On evaporating the substance under examination on the water-bath, with a few drops of the reagent, distinctive colorations are given by the various alkaloids.

D.

DACCOMO (*filicic acid*).—A solution of filicic acid in ether gives, when shaken with an aqueous

solution of copper acetate, a flocculent bright green precipitate of the copper salt.

DACLIN (*pure water of bitter almonds*).—The sample is distilled and the distillate treated with cocaine, which gives a crystalline precipitate of cocaine hydrocyanide. Artificial almond-water does not show this reaction.

DACLIN (*santonine in urine*).—Ten c.c. of the urine are shaken with 5 c.c. of chlorofrom, the mixture left to separate, and the chloroform layer decanted, and evaporated at a gentle heat. The residue is divided into two portions. One of these is gradually heated with 1 to 2 drops of pure sulphuric acid, and, in the presence of santonine, a violet coloration immediately appears. The other portion is treated with 2 drops of an alcoholic solution of potassium hydroxide, which causes a bright rose coloration to appear.

DAHLMANN (*lignin in paper*).—A 0·1 per cent. solution of sodium aurochloride gives a yellow coloration with lignin, and a red-brown coloration with sulphite cellulose and soda cellulose, whilst the cellulose of cotton remains unaltered.

DAHNON (*arbutin*).—When arbutin is moistened with strong nitric acid, then heated with a mixture of 1 volume of sulphuric acid with 8 volumes of alcohol, and subsequently treated with an excess of potassium carbonate solution, it gives violet coloration.

DAVID (*gallic and gallotannic acids*).—On treating a solution of gallotannic acid with a solution of barium chloride and potassium hydroxide a red precipitate is obtained, the intensity of the colour of which gradually increases. Gallic acid, under the same conditions, gives a blue precipitate.

DAVY (*alkaloids*).—The reagent consists of a 10 per cent. solution of sodium nitroprusside;

it forms microcrystalline precipitates with various alkaloids.

DAVY (*phenol*).—On adding sulphomolybdic acid to a solution containing phenol a yellow coloration, changing to yellowish-brown, is immediately obtained. Afterwards the colour changes to red-brown, and finally to reddish-purple. If the phenol solution is diluted it does not give the reddish-purple coloration, but an olive-green coloration, which changes rapidly to blue.

DAY (*pus in urine*).—The reaction consists in adding 1 or 2 drops of oxidised guaiacum tincture to the urine; in the presence of pus a blue coloration is produced.

DEBRUN (*coal-tar colours in wine*).—Ten c.c. of the wine are heated for one minute with 0·1 grm. of a mixture of 1 part of zinc oxide and 2 parts of mercuric acetate. Genuine wine is decolorised, whereas wine containing coal-tar colours remains persistently red.

DEEN (VAN) (*blood*).—A dilute solution of blood gives a blue coloration when treated with a few drops of guaiacum tincture and of ozonised oil of turpentine.

DEGENER (*dextrose in urine*).—The reagent is a modification of Fehling's solution.

DEISS (*cotton oil in olive oil*).—Ten c.c. of the oil are dissolved in 100 c.c. of ether, and the solution is shaken with 5 c.c. of a saturated solution of lead acetate. On shaking the mixture with 5 c.c. of ammonia solution, a more or less pronounced yellowish-red coloration is obtained in the presence of cotton oil.

DELAFIELD (*stain for microscopy*).—To 100 c.c. of a saturated solution of ammonium alum are added 4 grms. of hæmatoxylin dissolved in 25 c.c. of absolute alcohol, and the solution is exposed to the light for three or four days in an open bottle. The liquid is then filtered, and the

filtrate mixed with 100 c.c. of glycerin and 100 c.c. of methyl alcohol, and exposed to the light until the colour no longer changes. It is then filtered again and kept in closed bottles.

DELF (*alkaloids*).—(1) A solution of mercuric iodide in potassium iodide (see MAYER). (2) Potassium platinocyanide.

DELF-SCHWARZENBACH (*alkaloids*).—The reagent consists of nitric acid and ammonia. Characteristic colorations are obtained with certain alkaloids.

DEMSKI-MORAWSKI (*resin oils in mineral oils*).—The test is based upon the solubility of oils in acetone, and on the different behaviour of the solutions towards polarised light.

DENIGÈS (*acetone*).—The reagent consists of a solution of 5 grms. of mercuric oxide in 20 c.c. of strong sulphuric acid and 100 c.c. of water. It is heated on the water-bath with an equal volume of the solution under examination; in the presence of acetone a turbidity or white precipitate is obtained.

DENIGÈS (*aceto-acetic acid*).—A liquid containing aceto-acetic acid gives a bright red coloration on the addition of sodium nitroprusside.

DENIGÈS (*citric acid*).—Five grms. of mercuric oxide are dissolved in a mixture of 100 c.c. of water and 20 c.c. of strong sulphuric acid. If a solution containing citric acid be heated to boiling with one-twentieth of its volume of the reagent, and from 3 to 4 drops of N/10 potassium permanganate solution added, a white crystalline precipitate will be obtained. Sensitiveness = 1 : 2,000.

DENIGÈS (*nitrous and nitric acids*).—The reagent consists of an aqueous 5 per cent. solution of antipyrin. When 1 c.c. of the solution under examination is heated with 3 to 4 drops of sulphuric acid and 10 drops of the reagent are

added, after cooling, a greenish-blue to greenish-yellow coloration is obtained in the presence of nitrous acid. On adding to this mixture an additional 3 c.c. of sulphuric acid, a reddish-orange coloration is obtained in the presence of nitric acid, and on dilution with water the colour is changed to carmine-red.

DENIGÈS (*tartaric acid*). —The reagent consists of a solution of 2 grms. of resorcinal and 0·5 c.c. of sulphuric acid in 100 c.c. of water. The substance under examination is heated to 125° C. with 1 c.c. of the reagent; and if tartaric acid be present the solution is coloured red. Any oxidising substances present should be reduced by means of zinc and hydrochloric acid.

DENIGÈS (*uric acid*). On evaporating a trace of uric acid with bromine water to dryness, and treating the residue with a little strong sulphuric acid and a few drops of benzene containing thiophen, a bright blue coloration is produced.

DENIGÈS (*methyl alcohol in ethyl alcohol*). To 0·1 c.c. of the alcohol are added 1·5 c.c. of a 1 per cent. solution of potassium permanganate and 0·2 c.c. of sulphuric acid. After three minutes, the excess of permanganate is decomposed by the addition of oxalic acid (1 c.c. of a saturated solution) and, subsequently, of sulphuric acid. The colourless liquid is then treated with 5 c.c. of magenta bleached with sulphurous acid (see SCHIFF). In the presence of even a trace of methyl alcohol, a violet coloration is produced within fifteen minutes.

DENIGÈS (*anilides*). —All anilides give a yellowish-red precipitate when heated with an alcoholic solution of sodium hypobromite.

DENIGÈS (*bromine*). —The reagent is prepared by heating to boiling 5 c.c. of a 1 per cent. aqueous solution of strychnine sulphate with 5 c.c. of pure hydrochloric acid and 4 to 5 grms. of pure

granulated zinc, allowing the mixture to stand for five to ten minutes at the ordinary temperature, and then cooling it in water, and decanting the supernatant liquid. On shaking 1 c.c. of the reagent with 5 c.c. of a solution containing not more than 1 grm. of free bromine per litre, a purple coloration is obtained. When sufficiently diluted the solution shows absorption bands in the yellow part of the spectrum. In more concentrated solution the dark band extends towards the blue, but not towards the red part of the spectrum. Sensitiveness, 0·01 mgrm. per c.c.

DENIGÈS (*chlorates*).—A solution of 2 grms. of resorcinol in 100 c.c. of water containing 0·5 grm. of sulphuric acid gives, in the cold, a green coloration with chlorates.

DENIGÈS (*distinction between arsenic and antimony deposits*).—Ten grms. of ammonium molybdate and 25 grms of ammonium nitrate are dissolved in 100 c.c. of hot water. When cold, the solution is treated with 100 c.c. of nitric acid, then heated for ten minutes on the water-bath, allowed to stand for forty-eight hours, and filtered. The solution of the spots in nitric acid is treated with 5 drops of this reagent, which, in the presence of 0·001 mgrm. of arsenic, gives a yellow precipitate of ammonium arsenomolybdate.

DENIGÈS (*benzoyl group*).—A small quantity of the substance is heated to 120° C. with 3 c.c. of formaldehyde in sulphuric acid (2 c.c. of 40 per cent. formaldehyde solution in 100 c.c. of sulphuric acid). A red-brown coloration is obtained, and the solution shows a large absorption line in the green part of the spectrum. Other substances, such as phenols, opium bases, etc., give a similar coloration, but usually in the cold, and, in any case, below 100° C.

DENIGÈS (*mercaptans*).—The reagent consists of a 1 per cent. solution of isatin in strong sulphuric acid. One c.c. of strong sulphuric acid is mixed with a small quantity of the reagent, and on adding to the mixture an alcoholic solution of mercaptan a bright green coloration is obtained. Aldehydes and higher alcohols interfere with this reaction. Should they be present, the solution under examination is treated with sodium hydroxide, and then diluted with water, and sodium nitroprusside is added. In the presence of mercaptans a red coloration is obtained.

DENIGÈS (*copper*).—A solution of copper gives a red-violet coloration on adding an excess of potassium bromide and sulphuric acid.

DENIGÈS (*ferrous salts*).—The reagent consists of a solution of alloxan. It gives with ferrous salts a blue coloration on the addition of sodium hydroxide. This reagent also gives characteristic colorations with other salts:—Zinc and cadmium, carmine-red; magnesium, violet; manganese, reddish-blue; cobalt, claret-red; and nickel, yellowish-brown, changing to deep red.

DENIGÈS (*manganese salts*).—A dilute solution containing manganese gives a black precipitate with sodium hypobromite. On heating the solution, it assumes a red colour, owing to the formation of potassium permanganate.

DENIGÈS (*stannous salts*).—The reagent is prepared by boiling for fifteen minutes a solution of 1 grm. of brucine in 10 c.c. of cold nitric acid and 500 c.c. of water. Stannous salts impart a reddish-violet coloration to this solution.

DENIGÈS (*thiophen in benzene*).—Five grms. of mercuric oxide are dissolved in 20 c.c. of strong sulphuric acid and 100 c.c. of water. Ten c.c. of this solution are mixed with 30 c.c. of methyl alcohol free from acetone, and 10 c.c. of the mixture are treated with 1 c.c. of the benzene

under examination. In the presence of as little as 0·001 per cent. of thiophen a precipitate or turbidity is obtained after a few seconds.

DENIGÈS (*hydrogen peroxide*).—On adding to hydrogen peroxide 1 c.c. of a 10 per cent. aqueous solution of ammonium molybdate and 1 c.c. of sulphuric acid, an intense yellow coloration is produced.

DENIGÈS (*tyrosin*).—The reagent consists of a mixture of 2 c.c. of sulphuric acid with 4 drops of a mixture of 5 c.c. of aldehyde with 10 c.c. of 90 per cent. alcohol. On adding to the solution thus obtained a trace of tyrosin, the mass immediately assumes a red colour.

DESBASSIN (*nitric acid*).—This is the well-known zone reaction with sulphuric acid and ferrous sulphate (black ring).

DESESQUELLE (*phenols in urine*).—Fifty c.c. of the urine are shaken with 2 c.c. of chloroform, and the chloroform extract separated, and gently heated with a fragment of potassium hydroxide. The latter becomes coloured in a characteristic way, and produces a flocculent precipitate, the colour of which varies with the nature of the phenol. For example, β-naphthol gives a greenish-blue coloration.

DEVOTO (*peptones in urine*).—All the other proteins are precipitated by saturating the hot solution with crystallised ammonium sulphate, and the filtrate is tested for peptones by means of the biuret reaction.

DE-VRY (*quinine*).—A solution of quinoidine sulphate (8 parts) in dilute sulphuric acid (5 per cent.) is gradually treated with a potassium iodide solution of iodine. The precipitate is washed, dried, and dissolved in six times its volume of 92 to 94 per cent. alcohol, the solution filtered, the filtrate evaporated, and the residue dissolved in five times its weight of alcohol. This

solution gives with solutions of quinine a precipitate of quinine iodosulphate.

DIETERICH (*aloes and aloine*).—(1) On evaporating an extract of aloes on the water-bath with a few drops of nitric acid a residue is obtained, which, when dissolved in alcohol, forms a deep red solution, changing to pink on the addition of an alcoholic solution of potassium cyanide.

(2) An aqueous solution of the residue gives, when treated with gold chloride, colorations which vary with the nature of the aloine. The aloine from Cape and Socotra aloes gives a raspberry-red coloration; barbaloine gradually gives a violet coloration; nataloine, reddish violet; and curacoa-aloine, a brick-red coloration.

(3) On adding tannin to an aqueous solution of the residue a turbidity is produced in the presence of barbaloine. The aqueous solution of the ordinary residue remains clear, on the addition of potassium bromide solution containing bromine, in the case of nataloine, but gives a turbidity with the other forms of aloine.

DIETERICH (*uric acid*). A solution of sodium hypochlorite containing bromine gives a pink coloration in the presence of uric acid.

DITTMAR (*alkaloids*).—The reagent consists of a solution of iodine chloride, which gives yellow or brown precipitates with alkaloids.

DI-VETERE (*castor oil in olive oil*).—Five c.c. of hydrochloric acid (sp. gr. 1·18) are shaken in a graduated test-tube with 10 c.c. of the oil. In the presence of castor oil the liquid separates, on standing, into three layers, the uppermost consisting of olive oil, the middle of castor oil, and the bottom of acid. The depth of the middle layer will afford an estimate of the quantity of castor oil present.

DOBBIN (*caustic alkalies in carbonates*).—A solution of 1 grm. of potassium iodide in 50 c.c. of water is treated with 5 per cent. mercuric chloride solution until a persistent precipitate is obtained. The liquid is then filtered, and 0·3 grm. of ammonium chloride is dissolved in the filtrate and sodium hydroxide added until a precipitate begins to form, when the solution is filtered and diluted to 200 c.c. The reagent gives a yellow coloration with traces of caustic alkali in alkali carbonates.

DODGE-OLCOTT (*Gurjun balsam in Copaiba balsam*).—On treating a solution of 4 drops of the balsam in 15 c.c. of acetic acid with 6 drops of strong nitric acid, a rose coloration, changing to reddish-purple, is obtained in the presence of Gurjun balsam.

DONATH (*chromic acid*).—Chromic acid liberates iodine from a solution of potassium iodide, and this iodine will dissolve in carbon bisulphide, forming a violet solution.

DONATH (*cobalt*).—A concentrated solution of sodium or potassium hydroxide gives an intense blue coloration when treated with a few drops of a solution containing cobalt. On heating the liquid, the colour becomes brighter.

DONATH (*tarry substances in ammonia solution*).—The ammonia solution acidified with sulphuric acid decolorises dilute potassium permanganate solution when tarry substances are present.

DONATH (*rosin in yellow beeswax*).—Five grms. of the wax are heated for one minute with 20 to 25 grms. of nitric acid, and the mixture treated, first with 20 c.c. of water, and then with ammonia solution in excess. In the presence of rosin the liquid will be of a red-brown colour, whilst pure wax gives a yellow solution.

DONOGANY (*blood in urine*).—Ten c.c. of the urine are treated with 1 c.c. of ammonium sulphide

and 1 c.c. of pyridine. In the presence of blood, the liquid becomes reddish-orange.

DRAGENDORFF (*biliary acids in urine*).—The urine is acidified with sulphuric acid and shaken, first with petroleum spirit to remove colouring matters, and then with amyl alcohol to extract biliary pigments. After neutralisation with ammonia, the liquid is evaporated to dryness, and the residue taken up with a little water. The aqueous solution, when treated with a fragment of sugar and added to sulphuric acid so as to form an upper layer, gives a characteristic red coloration.

DRAGENDORFF (*alkaloids*).—Five grms. of bismuth iodide are dissolved in the necessary quantity of a hot strong solution of potassium iodide (1 : 1), the liquid filtered, and the filtrate mixed with an equal quantity of potassium iodide solution. This reagent gives red-brown precipitates with various alkaloids.

DRAGENDORFF (*narcotine*). -On dissolving a little narcotine in strong sulphuric acid, with the aid of gentle heat, it first gives a crimson-red coloration, then forms bluish-violet streaks, and finally the liquid becomes reddish-violet.

DRAGENDORFF-PODWYSTOTZKI (*erithrosclerotin in flour*).—The material is exhausted with alcohol containing sulphuric acid, and then extracted with ether. The extract is filtered, and the filtrate is extracted with sodium bicarbonate solution, and examined spectroscopically whether it shows an absorption band in the green, and not in the blue part of the spectrum.

DRAPER (*castor oil*).—The oil is treated with nitric acid, and the acid solution neutralised with sodium hydroxide, and heated to boiling. In the presence of castor oil the odour of œnanthic ether will be perceptible.

DRECHSEL (*biliary acids in urine*).—The reaction

is a modification of that of Pettenkofer, and consists in the use of phosphoric acid in place of sulphuric acid. The chromatic reactions observed on heating the liquid are the same.

DRECHSEL (*dextrose in urine*).—Ten drops of the urine are made alkaline with sodium hydroxide, and filtered, and the filtrate diluted with 20 c.c. of water, and then boiled for five minutes with 20 drops of Fehling's solution. Glucuronic acid and creatinine do not cause reduction at such dilution.

DRESCHER (*alcohol in essential oils*).—A solution of potassium bichromate (1 part) in 10 parts of nitric acid gives, in the presence of alcohol, a pungent odour of the particular essential oil present, and a distinctive coloration.

DUDLEY (*gallic acid*).—A dilute aqueous solution of picric acid treated with an excess of ammonia gives a red coloration, changing to green when added to gallic acid.

DUDLEY (*dextrose*).—A solution of basic bismuth nitrate in a mixture in equal parts of nitric and acetic acids is cautiously diluted with water, and filtered if necessary. The solution under examination is made alkaline with sodium hydroxide, and heated with a few drops of the reagent. In the presence of dextrose a brownish-black coloration is obtained.

DUFLOS (*aniline*).—On adding dilute sulphuric acid and lead peroxide to aniline a green coloration is produced.

DUMONT (*artificial camphor*).—A solution of artificial camphor, or of natural camphor adulterated with the artificial product, gives a persistent turbidity or a precipitate with ammonia.

DUPONY (*boiled and unboiled milk*).—Fresh unboiled milk to which hydrogen peroxide has been added gives an orange-yellow coloration with guaiacum tincture, a red coloration and forma-

tion of green crystals of quinby drone with hydroquinone, a bluish-violet coloration with α-naphthol and a deep violet coloration with paraphenylenediamine. Boiled milk does not give these reactions.

DUPONY (*chloroform*).—On boiling 0·5 c.c. of a 5 per cent. alcoholic solution of thymol for half a minute with 1 drop of chloroform and a little potassium hydroxide there is produced a yellowish-red coloration, which changes to violet on the cautious addition of 1 c.c. of sulphuric acid, or when boiled again.

DURAL (*microscopic stain*). The reagent consists of a solution of carmine mixed with an alcoholic solution of aniline blue.

DUSART-BLONDOT (*phosphorus*).—Phosphorus and phosphoric acid give a green colour to a hydrogen flame.

DUYK (*dextrose*).—To 25 c.c. of a 20 per cent. solution of nickel sulphate are added 20 c.c. of sodium hydroxide solution and 50 c.c. of a 6 per cent. solution of tartaric acid. When the solution thus prepared (which should be of a pale green colour) is boiled with a liquid containing dextrose, a brown or black coloration will be obtained.

DUYK (*oil of turpentine in oil of lemon*). The lemon oil is distilled, and the first drops of the distillate are collected on calcium phosphate, which is then mixed with water, and the liquid filtered. On treating the filtrate with magenta decolorised with sulphurous acid, a pink coloration will be obtained in the presence of oil of turpentine.

E.

EBER (*tainted meat*).—The reagent consists of 1 part of hydrochloric acid, 3 parts of alcohol,

and 1 part of ether. A fragment of the meat is added to a few drops of the reagent in a test-tube, and if the meat is unsound a white turbidity will be formed at the juncture of the liquids.

EBOLI (*cantharidine*).—The test consists in heating the cantharidine with strong sulphuric acid and a trace of potassium bichromate, when a green coloration, changing in a few hours into a green turbidity, is obtained.

EBSTEIN-MULLER (*pyrocatechol in urine*).—The reagent consists of a dilute solution of ferric chloride. In the presence of pyrocatechol the urine assumes a green coloration, which changes to violet on the addition of ammonia.

EGGER (*free mineral acids*).—When a solution containing free mineral acid is heated with cholic acid and furfural a red coloration is obtained.

EHRLICH (*bilirubin in urine*).—When equal volumes of the urine and of dilute acetic acid are mixed, and the liquid treated with Ehrlich's diazo reagent, a dark coloration, changing to violet on the addition of acid, is obtained. On extracting such urine with chloroform, and adding an equal volume of the diazo reagent and of strong hydrochloric acid, a violet coloration, changing to blue, is obtained.

EHRLICH (*stain for bacteriology*).—(1) One hundred parts of a 5 per cent. aqueous solution of aniline oil are mixed with 11 parts of a concentrated alcoholic solution of magenta or gentian violet.

(2) Tri-acid solution.—125 grms. of a saturated aqueous solution of magenta, and 150 grms of a saturated aqueous solution of methyl green are mixed with 100 grms. of glycerin, 200 grms. of absolute alcohol, and 300 c.c. of water.

(3) A concentrated aqueous solution of methylene blue.

EHRLICH (*diazo reaction*).—According to Ehrlich,

certain pathological urines (typhus, pulmonary tuberculosis, etc.) give a carmine-red or scarlet coloration when treated with a dilute solution of diazobenzenesulphonic acid followed by ammonia, whereas normal urines give only a yellow coloration. The diazo test is carried out as follows:—Ten c.c. of the urine are mixed with 10 c.c. of a 5 per cent. solution of sulphanilic acid and 5 per cent. of officinal hydrochloric acid. The mixture is treated with 2 drops of a 0·5 per cent. solution of sodium nitrite, and is then shaken with an excess of ammonia.

EHRLICH (*indican in urine*).—The reagent consists of a solution of 0·33 grm. of dimethylaminobenzaldehyde in 50 c.c. of water and strong hydrochloric acid. On heating 1 c.c. of the urine with an equal volume of the reagent, cooling the mixture, and treating it with dilute potassium hydroxide or ammonia solution in excess, a bright red coloration indicates the presence of indican.

EHRLICH (*stains for microscopy*).—(1) Three grms. of hæmatoxylin in 90 grms. of alcohol are treated with a mixture of 6 grms. of glacial acetic acid, 120 grms. of glycerin, and 120 c.c. of water, saturated with alum.

(2) A concentrated solution of dahlia violet in 100 c.c. of water, 50 c.c. of alcohol, and 12 c.c. of acetic acid.

(3) A solution of gentian violet in 15 c.c. of alcohol and 100 c.c. of aniline water.

EHRLICH (*acetone*).—On adding azobenzenesulphonic acid, and then alkali, to a solution of acetone, an intense red coloration is obtained.

EHRLICH-BIONDI (*triacid mixture*).—This is a mixture of saturated aqueous solutions of methyl orange G, acid magenta, and methyl green, in the proportions of 10 : 3 : 5.

EIBART (*quinine*).—On treating an aqueous solu-

tion of quinine first with bromine water, then with a solution of mercuric cyanide, and lastly with calcium carbonate, a red coloration is obtained. Sensitiveness = 1 : 500,000. Narcotine and morphine give the same coloration.

EINHORN (*dextrose*).—The urine is mixed with yeast in a saccharometer vessel, and the amount of dextrose is calculated from the yield of carbon dioxide evolved.

EISELT (*melanin in urine*).—The urine is treated with chromic acid, potassium bichromate, and nitric acid, and a brown or black coloration is obtained in the presence of melanin.

ELLRAM (*acetone in urine*).—Fifty c.c. of the urine are acidified with 4 c.c. of 30 per cent. acetic acid, and part of the mixture is distilled. Two to 3 c.c. of the distillate are treated with 1 drop of a 5 per cent. aqueous solution of formaldehyde, followed by 2 c.c. of strong sulphuric acid. In the presence of acetone a red coloration is produced at the zone of contact of the liquids. Sensitiveness = 1 : 2,000.

ELLRAM (*thiocyanic acid*).—(1) A blue coloration is obtained with a mixture of vanadic acid and sulphuric acid. Sensitiveness = 1 : 12,000.

(2) Molybdic acid with sulphuric acid gives a yellow coloration, changing to blood-red. Sensitiveness = 1 : 1,000,000.

ELLRAM (*Copaiba balsam*).—On treating the sample with a few drops of a 1 per cent. solution of vanillin in strong sulphuric acid, a red, orange, or violet coloration is obtained, the intensity of which varies with different kinds of balsam. Gurjun balsam, colophony, camphor, and alkaloids also give colour reactions with this reagent.

ENDEMANN (*phenols*).—The phenol under examination is treated with formaldehyde, and evaporated to dryness, and strong sulphuric acid is

added to the residue. The following colorations are obtained :—Phenol, magenta red ; salicylic acid and pyrogallic acid, red ; eugenol and hydroquinone, brown ; guaiacol, violet ; resorcinol, scarlet ; and α- and β-naphthol, green.

ERDMANN (*alkaloids*).—The reagent consists of 6 drops of nitric acid (sp. gr. = 1·25) in 100 c.c. of water. Ten drops of this solution are added to 20 grms. of strong sulphuric acid. Many alkaloids give distinctive colorations with this reagent. For example, papaverine, apomorphine, and curarine give violet colorations ; thebaine, blood red ; veratrine, orange ; berberine, olive-green ; digitaline, red-brown, changing after twelve hours to cherry-red ; morphine, red and then greenish-brown ; and piperine, pale yellow.

ERDMANN (*nitrites in water*).—The reagent is a solution of 0·2 grm. of sodium sulphanilate in 100 c.c. of water containing hydrochloric acid. Fifty c.c. of the water under examination are treated with 5 c.c. of this solution, and then, after ten minutes, with 0·5 grm. of amino-naphtholdisulphonic acid in the form of powder. A Bordeaux-red coloration is obtained in the presence of even traces of nitrous acid.

ERLIKI (*stain for microscopy*).—This consists of a solution of 2·5 grms. of methyl green in 100 c.c. of 1 per cent. acetic acid.

ERLWEIN-WEYL (*ozone*).—A solution of 0·1 grm. of metaphenylenediamine in 90 c.c. of water and 10 c.c. of 5 per cent. sodium hydroxide solution gives a red coloration with ozone. Nitrous acid and hydrogen peroxide do not change the colour of the reagent.

ESBACH (*albumin in urine*).—The reagent consists of 10 grms. of picric acid, 20 grms. of citric acid, and 970 c.c. of water. In the presence of albumin a yellow precipitate is obtained, and a quantitative estimation may be made by

carrying out the test in a special graduated apparatus.

EYKMANN (*phenol*).—A red ring is produced at the zone of contact on adding strong sulphuric acid to a solution of phenol mixed with a few drops of spirit of nitrous ether.

EWALD (*hydrochloric acid in gastric juice*).—Three drops of the liquid under examination are added to a mixture of 2 drops of a 10 per cent. solution of potassium thiocyanate and 0·5 c.c. of a neutral solution of iron acetate, diluted to 10 c.c. In the presence of hydrochloric acid, a violet cloud is produced at the zone of contact, and when this disappears the colour of the liquid becomes deep brown.

EWINS (*adrenaline*).—A red coloration is produced on heating adrenaline with a 0·1 per cent. solution of potassium persulphate. Sensitiveness = 1 : 5,000,0000.

F.

FABRIS (*oil of turpentine in lemon oil*).—When 1 to 2 c.c. of the essential oil is heated with a crystal of picric acid an intense red coloration is obtained in the presence of oil of turpentine, but no coloration with pure oil of lemon. The coloration with turpentine is much intensified by dissolving 1 c.c. of the oil in 5 c.c. of chloroform.

FABY (*codeine*).—A blue coloration is produced when a trace of codeine is triturated with 2 drops of sodium hypochlorite solution, and treated with 4 drops of strong sulphuric acid.

FALK (*blood*).—Alcohol, chloroform, and ozonised oil of turpentine (20 grms. of each) are mixed with 2 grms. of glacial acetic acid. The mixture is diluted with water until a persistent turbidity is obtained, and a trace of guaiacum resin is

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dissolved in the solution. This reagent gives a blue coloration with blood.

FAURE (*colouring matters in wine*). Two c.c. of the wine are treated with 10 drops of a 2 per cent. solution of tannin, and then with 6 drops of a 6 per cent. solution of gelatin. Natural colouring matters in the wine are precipitated, whilst coal-tar colours are not affected.

FEHLING (*dextrose*). (1) 34·639 grms. of crystallised copper sulphate are dissolved in 500 c.c. of water. (2) A solution of 173 grms. of potassium sodium tartrate and 50 grms. of sodium hydroxide in 500 c.c. of water. Equal parts of the two solutions are used for the test, and 10 c.c. of the reagent is equivalent to 5 mgrms. of dextrose. In the presence of dextrose the solution is decolorised on boiling, and yields a red deposit of cupeous oxide.

FENTON (*tartaric acid*). On adding to a solution of tartaric acid, or a tartrate, a trace of ferrous sulphate, then 2 drops of hydrogen peroxide, and finally an excess of sodium or potassium hydroxide, a violet coloration, which in concentrated solutions becomes black, is obtained.

FERRARO (*castor oil in olive oil*). Castor oil will dissolve a solution of magenta in alcohol (0·05 per cent. in absolute alcohol). Hence, on shaking adulterated olive oil with this reagent (5 : 25), castor oil will separate, forming a pink layer at the top, the depth of which stands in relationship to its quantity, whilst the lower yellow layer consists of the olive oil.

FERRARO (*santonine, veratrine, resorcinol*). On treating a small quantity of santonine in a watch-glass with a few drops of sulphuric acid and with alcohol, a distinctive red coloration is obtained. Under the same conditions veratrine gives a bright violet coloration, whilst resorcinol gives first a yellow coloration, which soon

changes to blood-red, but always shows a characteristic yellow zone.

FISCHER (*hydrogen sulphide*).—The liquid under examination is treated with a tenth of its volume of strong hydrochloric acid, and is then mixed with a fragment of *p*-amino-methylaniline, and, when this has dissolved, from 1 to 2 drops of dilute ferric chloride solution are added. In the presence of hydrogen sulphide a pronounced blue coloration is obtained. The reaction is capable of detecting 0·0000182 grm. of hydrogen sulphide per litre.

FISCHER (*cobalt salts*).—An aqueous solution of potassium nitrite acidified with acetic acid gives, with salts of cobalt, a yellow precipitate of potassium cobaltinitrite.

FISCHER (*sugars*). Phenyl hydrazine and sodium acetate, when heated with sugars, yield crystalline osazones.

FLEISCHL (*biliary pigments*).—The urine is treated with a concentrated solution of sodium nitrate, and strong sulphuric acid is then added from a pipette. The layer of acid which forms at the bottom will show the same colour reaction as in Gmelin's test.

FLEMMING (*fixative for microscopy*).—This consists of a mixture of 10 c.c. of 2 per cent. osmic acid solution, 20 c.c. of 1 per cent. chromic acid solution, and 10 c.c. of acetic acid. The solution is kept in the dark.

FLORENCE (*sperm stains*).—Potassium iodide, 1·65 grms.; iodine, 2·54 grms.; and water, 30 c.c. One drop of the reagent added to the liquid under examination forms brown crystals resembling hæmin crystals (reaction of all substances containing cholesterol).

FLÜCKIGER (*gurjun balsam in copaiba balsam*).—A solution of copaiba balsam in carbon bisulphide is shaken with 1 drop of a cold mixture

of equal parts of sulphuric and nitric acids. In the presence of gurjun balsam a reddish-violet coloration is obtained.

FLÜCKIGER (*quinine*). –A solution of quinine gives an emerald-green coloration when treated with bromine water and excess of ammonia (thalleioquin reaction).

FLÜCKIGER (*cocaine*).—On heating cocaine with sulphuric acid (sp. gr. 1·84) white vapours are evolved, which on cooling deposit crystals of benzoic acid.

FLÜCKIGER (*morphine*).—On adding a crystal of morphine to a mixture of basic bismuth nitrate and sulphuric acid, the acid assumes a blackish-brown colour.

FOCKER (*uric acid in urine*). –The addition of a solution of ammonium chloride to urine, previously rendered alkaline with sodium hydroxide, produces a precipitate of acid ammonium urate, which is only sparingly soluble, and so may be separated and weighed.

FODOR (*carbon monoxide in air*).—The air is made to pass through blood, which is then heated for some hours in the presence of potassium hydroxide, whilst simultaneously a current of air is passed through the same blood. On now passing this air through a solution of palladium chloride a darkening of the liquid indicates the presence of carbon monoxide.

FOL (*fixative for microscopy*).—This consists of a filtered mixture of 10 parts of a saturated aqueous solution of picric acid, 25 parts of a 1 per cent. aqueous solution of chromic acid, and 65 parts of water.

FRANKLAND (*nitrous acid*). –The reagent is a slightly acid solution of sulphanilic acid and phenol. When mixed with a solution containing nitrous acid, to which ammonia is then added, a red coloration is produced.

FRAUDE (*alkaloids*). –The reagent consists of an aqueous solution of perchloric acid (sp. gr. 1·13), which gives distinctive colorations with certain alkaloids. Aspidospermine gives a magenta-red coloration, brucine a madder-brown, and strychnine a yellowish-red coloration.

FRESENIUS (*phenols*).—On boiling the phenol with a solution of mercurous nitrate containing a trace of free acid, an odour of salicylic aldehyde is emitted, and metallic mercury separates.

FREY (*stain for microscopy*).—Magenta crystals 0·01 grm.; absolute alcohol, 15 to 20 drops; water, 15 c.c.

FRÖHDE (*hydrocyanic acid*). –When a cyanide is fused on platinum foil with sodium thiosulphate, the mass dissolved in water, and the solution treated with ferric chloride, a blood-red coloration is obtained.

FRÖHDE (*alkaloids*), –The reagent consists of a freshly-prepared solution of 0·01 grm. of sodium molybdate in 1 c.c. of strong sulphuric acid. It gives characteristic colorations with certain alkaloids and glucosides. For example, aconitine gives a yellowish-brown coloration; brucine, red, changing to yellow; codeine, green and then blue; colchicine and coniine, yellow; delphine, reddish-brown; digitaline, orange and then cherry-red; morphine and papaverine, violet; solanine, cherry-red; and thebaine, a red coloration.

FRÖHDE (*biliary pigments*).—A zone of a green to red colour is obtained when the urine is cautiously poured on to the surface of nitric acid saturated with oxides of nitrogen.

FURBRINGER (*albumin in urine*).—The reagent consists of a mixture of mercuric chloride, sodium chloride, and citric acid. This solution gives, with albuminous urine, a turbidity or a flocculent precipitate. It also precipitates uric

acid, and it is therefore necessary to dilute the urine before applying the test.

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GABBET (*stain for bacteriology*).—One part of sulphuric acid is diluted with 3 parts of water, and sufficient methyl blue is added to give an intense blue solution.

GAGLIO (*mercury vapour in air*).—An aqueous 0·02 per cent. solution of palladium chloride turns black, or becomes turbid, on contact with mercury vapour.

GALIPPE (*albumin in urine*).—A solution of picric acid is added drop by drop to the urine; in the presence of albumin, a turbidity is produced on the addition of each drop.

GALLOIS (*inosite in urine*).—The urine is freed from dextrose by means of fermentation, and from albumin by boiling, and is then concentrated to a small volume, and treated with a drop of mercurous nitrate solution. The resulting precipitate is dried in a crucible, and, in the presence of inosite, the dry residue, when gently heated, gives a more or less intense dark red coloration.

GANASSINI (*hydrogen sulphide*).—A solution of 1·25 grms. of ammonium molybdate in 50 c.c. of water is mixed with a solution of 2·5 grms. of potassium thiocyanate in 45 c.c. of water, and 5 c.c. of strong hydrochloric acid are added to the mixture. If the liquid becomes red, a small quantity of oxalic acid is added until it has a greenish-yellow colour. Strips of paper impregnated with this solution give an intense violet coloration in presence of hydrogen sulphide.

GANASSINI (*tartaric acid*).—The solution to be tested for tartaric acid is boiled with red-lead

and filtered, and the filtrate is treated with an equal volume of 20 per cent. potassium thiocyanate solution, again boiled, and allowed to stand. In the presence of tartaric acid the liquid immediately becomes black owing to the formation of lead sulphide.

GAND (*dextrose*).—The reagent consists of an ammoniacal solution of copper sulphate, which when heated to 80° C., is decolorised by dextrose.

GANNTHER (*cotton-seed oil in lard*).—One c.c. of the melted lard, which has been freed from water, is dissolved in 10 c.c. of petroleum spirit, and this solution is vigorously shaken with 1 c.c. of strong sulphuric acid. In the presence of even 1 per cent. of cotton-seed oil, the liquid assumes an intense brown colour; whilst pure lard gives only a yellow coloration.

GANNTHER (*blood*). — The reagent consists of hydrogen peroxide, which is decomposed by blood, with the liberation of oxygen.

GARDINER (*tannic acids*).—A concentrated solution of ammonium molybdate gives a yellow precipitate with tannic acids. This reagent may also be used in microscopy.

GASSEND (*sesamé oil in olive oil*).—The test is a modification of Baudouin's reaction. Fifteen c.c. of the oil are shaken with 10 c.c. of the hydrochloric acid solution of sugar, and then treated with 2 to 3 c.c. of 10 per cent. sodium bisulphite solution, and allowed to stand for five minutes. The appearance of a persistent red coloration indicates the presence of sesamé oil.

GAUSE (*dextrose*).—A solution of 0·5 grm. of potassium ferrocyanide and 0·15 grm. of sodium hydroxide in 1 litre of water is decolorised by dextrose. Each c.c. of the reagent corresponds with 0·00015 grm. of dextrose.

GAUTIER (*egg albumin and blood albumin*).—The reagent consists of a mixture of 250 c.c. of

sodium hydroxide solution, 50 c.c. of copper sulphate solution, and 700 c.c. of glacial acetic acid. Ten c.c. of this mixture are treated with 2 c.c. of the solution under examination. Egg albumin gives a flocculent precipitate, whilst blood albumin does not produce even a turbidity.

GAWALOWSKY (*petroleum spirit and benzene*).—Picric acid is soluble in benzene, producing a bright yellow solution, whereas it is only very sparingly soluble in petroleum spirit, and without producing any appreciable coloration.

GAYON (*aldehydes and ketones*).—See SCHIFF'S reagent.

GEITHERR (*cocaine*).—On mixing a solution of a cocaine salt with 2 to 3 c.c. of chlorine water, and then with a few drops of a 5 per cent. solution of palladium chloride, a red precipitate is obtained, which is slowly decomposed by water.

GENTELE (*dextrose*).—The reagent is identical with that of GAUSE. It should be noted, moreover, that uric acid gives the same reaction as dextrose.

GERHARDT (*aceto-acetic acid in urine*).—The reaction consists in the red coloration which urine containing this acid or its esters gives with ferric chloride. Recently Iastrowitz has recommended the following modification: —The urine is treated with a dilute solution of ferric chloride in such a way that the two layers do not mix, and that the ferric chloride solution is of greater density. To ensure this, 6 c.c. of water are mixed with 6 to 20 drops of ferric chloride solution, according to the density of the urine, and 1 grm. of the urine is run on to the surface of the solution by means of a pipette. In the presence of aceto-acetic acid a red ring is formed at the zone of contact.

GERHARDT (*biliary pigments in urine*).—The urine is extracted with chloroform, and the extract is mixed with ozonised oil of turpentine, and with a little dilute potassium hydroxide solution. In the presence of biliverdine a green coloration is produced in the aqueous layer. On then treating the chloroform extract with iodine, and adding an excess of potassium hydroxide, the aqueous layer is coloured yellow, with green fluorescence, when urobilin is present.

GERRARD (*atropine*).—The reagent consists of a solution of 5 grms. of mercuric chloride in 95 grms. of 50 per cent. alcohol. On heating 1 mgrm. of atropine with 2 c.c. of this reagent, a red precipitate of mercuric oxide is obtained. The reaction is produced only by the free base, and not by its salts.

GERRARD (*dextrose*).—Fehling's solution is treated with 50 per cent. potassium cyanide solution until decolorised, and then mixed with an equal volume of fresh Fehling's solution. The blue solution thus obtained is quantitatively decomposed when boiled with dextrose.

GIBBE (*microscopic stain*).—A mixture of 2 grms. of magenta and 1 grm. of methylene blue is ground up, and treated with 3 c.c. of aniline oil dissolved in 15 c.c. of alcohol. Finally, 15 c.c. of water are added, and the solution is kept in well-closed bottles.

GIEMSA (*stain for microscopy*).—Azure blue, II., 3 grms.; eosin (B.A.), 0·8 grm.; pure glycerin, 250 c.c.; and methyl alcohol, 250 c.c.

GIESEL (*cocaine*).—On adding to a concentrated solution of a cocaine salt a 1 per cent. solution of potassium permanganate, drop by drop, a crystalline violet precipitate of cocaine permanganate is obtained.

GIGLI (*uric acid*).—Five c.c. of the urine are treated with a nitric acid solution of ammo-

nium molybdate. If a greenish precipitate is obtained, and this is treated with ammonia or sodium hydroxide solution until redissolved, a clear blue solution will be obtained.

GILLET-HAIN (*ketones*).—Aqueous solutions of ketones yield yellow crystalline precipitates with Nessler's reagent.

GIRARD (*coal-tar colours in wine*).—Twenty c.c. of the wine are treated with 4 c.c. of 10 per cent. potassium hydroxide solution, and 20 c.c. of 5 per cent. mercuric sulphate solution. Genuine wines yield a colourless filtrate, whilst those containing coal-tar dyes give a red filtrate.

GLUZINSKY (*biliary pigments in urine*).—A solution of a biliary pigment gives, when boiled with formaldehyde, an emerald-green coloration, which becomes amethyst-blue on the addition of hydrochloric acid. When extracted with chloroform, the green extract becomes amethyst-blue if biliverdine alone was present.

GMELIN (*biliary pigments in urine*).—The liquid containing the pigments is treated with nitric acid containing nitrogen oxides, in such a way that the two liquids do not mix, and that the acid falls to the bottom. At the zone of contact of the two liquids there is formed a ring, which gradually changes to the following colours: Green, blue, violet, red, yellow, in the progressive oxidation of the bilirubin and biliverdine.

GODEFROY (*alkaloids*).—A solution of antimony trichloride gives a white or yellow precipitate with solutions of the hydrochlorides of aconitine, atropine, quinine, cinchonine, piperine, strychnine and veratrine.

GODEFROY-LAUBENHEIMER (*alkaloids*).—Silicotungstic acid gives precipitates when added to the solution of hydrochlorides of many alkaloids.

GOLDMANN (*salophen*).—On heating a little salo-

phen with 2 per cent. sodium hydroxide solution a blue coloration is obtained.

GOLDSCHMIDT (*formaldehyde*).—When a solution containing formaldehyde is heated with hydrochloric acid and α-α-methylphenyl-hydrazine, a deep green coloration is produced.

GOLGI (*chrome-silver microscopic reagent*).—The preparation is fixed by treatment for a week in the dark with 1 per cent. osmic acid (2 parts) and Muller's solution (8 parts); then washed with water, stained with 0·5 per cent. silver nitrate solution, which is renewed until it remains clear for a week, and treated with creosote and Canada balsam.

GOPPELSRÖDER (*aluminium salts*).—An alcoholic solution of morine gives a green fluorescence, even with traces of a neutral salt of aluminium.

GORUP-BESANEZ (*peptones*).—The test is a modification of the biuret reaction.

GOSIO (*arsenic*).—Arsenical compounds are decomposed by *Penicillium brevicaule*, with the evolution of ethylarsine (garlic-like odour).

GOUVER (*albumin in urine*).—The reagent consists of a solution of mercuric cyanide in excess of potassium iodide solution. It precipitates albumin from urine as a white precipitate.

GRAHE (*cinchona bark*).—Cinchona bark, containing quinine, cinchonidine and its isomers, emits carmine-red vapours when heated in a test tube.

GRAHM (*stain for bacteriology*).—The following solutions are required:—(*a*) Gentian violet or methyl violet in aniline water; (*b*) a solution of 2 grms. of potassium iodide, and 1 grm. of iodine in 300 c.c. of water; (*c*) absolute alcohol; (*d* an alcoholic solution of safranine, vesuvine, or magenta.

GRANDEAU (*digitalin and digitalein*).—These compounds give a yellow coloration on treatment

with strong sulphuric acid, and the colour changes to red under the influence of bromine vapour. Digitonin and digitoxin do not give this reaction.

GRANDVAL-LAVOUX (*nitric acid*).—One hundred c.c. of the liquid are evaporated to dryness, and the residue is treated with 10 drops of a mixture of 7·5 grms. of phenol and 52·5 grms. of sulphuric acid. The product of this reaction is treated with ammoniacal water, and, if nitric acid is present, a yellow coloration, due to the formation of picric acid, is obtained. This reaction has been suggested for the detection of nitric acid in drinking water.

GRASSINI (*alcohol*).—Two c.c. of a 5 per cent. solution of cobalt chloride are mixed with 2 c.c. of a potassium thiocyanate solution, and the liquid under examination is added so as to form a separate layer. In the presence of alcohol the supernatant liquid soon becomes of an intense blue colour; in some cases the coloration is produced at the zone of contact.

GRENACHER (*stain for microscopy*).—(1) A little carmine is dissolved in 50 c.c. of 60 to 80 per cent. alcohol, 3 to 4 drops of hydrochloric acid added, and the liquid filtered. (2) From 2 to 3 grms. of carmine, and 4 grms. of borax are dissolved in 100 c.c. of boiling water, and the solution diluted with an equal volume of 70 per cent. alcohol, and filtered after standing for a long time.

GRIESS (*nitrous acid*).—The original reagent consisted of phenylenediamine, which gives a yellow coloration with nitrous acid. The modification of Ilosvay and Lunge, however, is also known as Griess's reagent; it is prepared as follows:—A solution of 0·5 grm. of sulphanilic acid in 150 c.c. of dilute acetic acid is mixed with a solution prepared by boiling

0·2 grm. of solid α-naphthylamine with 20 c.c. of water, decanting the colourless liquid, and adding it to 150 c.c. of dilute acetic acid. On adding 2 c.c. of the reagent to 50 c.c. of a solution containing nitrous acid a bright red coloration is obtained.

GRIMBERT-LECLERC (*apomorphine*).—Five c.c. of the solution are treated with 5 drops of a saturated solution of mercuric chloride and 5 drops of a 10 per cent. solution of sodium acetate, and the liquid cooled, and treated with 1 to 2 c.c. of amyl alcohol. In the presence of apomorphine the amyl alcohol becomes of an intense blue colour. Sensitiveness = 1 : 100,000.

GRÖSSMANN (*salts of nickel*).—A solution of dicyano-diamidine is heated to boiling point with a few drops of hydrochloric acid, the solution to be tested for nickel then added, and, finally, potassium hydroxide. In the presence of an appreciable amount of nickel, a yellow cystalline precipitate is obtained; otherwise it is formed after some time. The precipitate is insoluble in ammonia solution, but dissolves in potassium cyanide solution.

GRÜNHAT (*glycerin*).—On heating glycerin with potassium bisulphate, acrolein is formed, and emits a characteristic pungent odour. If the vapours evolved be passed through an ammoniacal solution of silver nitrate, metallic silver separates.

GUARESCHI (*alkaloids*).—The reagent consists of potassium platino-thiocyanate, which is prepared by adding 4 or 5 drops of chloroplatinic acid to a solution of 4 grms. of potassium thiocyanate. A 5 per cent. solution of the salt gives a precipitate with various alkaloids.

GUARESCHI (*bromine*).—Free bromine imparts an intense violet-blue coloration to Schiff's reagent (magenta decolorised by SO_2). The reaction is

extremely sensitive, a coloration being given by 1 drop of bromine water (1 : 1,000) in 1 c.c. of water.

GUARESCHI (*phenol*).—On heating phenol with potassium hydroxide and chloroform, a red mass, dissolving in alcohol to form a red solution, is obtained.

GUERIN (*albumin in urine*).—The reagent consists of a 10 per cent. alcoholic solution of sozoiodolic acid. On adding 10 drops of the reagent to 10 c.c. of albuminous urine a white precipitate, which does not disappear on heating, is obtained.

GUNNING (*acetone*).—The test depends on the formation of iodoform when tincture of iodine and ammonia solution are added to the liquid under examination.

GUNN-HARRISON (*adrenalin*).—Traces of adrenalin (fractions of a mgrm.) emit an odour of methylamine when treated with 5 drops of 10 per cent. sodium hydroxide solution.

GUNZBURG (*hydrochloric acid in gastric juice*).—The reagent consists of a solution of 2 grms. of phloroglucinol and 1 grm. of vanillin in 30 grms. of absolute alcohol. A few drops of this solution are evaporated with the same quantity of filtered gastric juice in a porcelain crucible. In the presence of free hydrochloric acid a red layer is formed. Should the acid be present in the proportion of 1 : 10,000 red crystals are produced, whilst in the proportion of 1 : 20,000 only red streaks appear.

GUTZEIT (*arsenic*).—Paper impregnated with silver nitrate turns yellow with black margin, in the presence of arsine.

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HABERMANN (*carbon monoxide*).—An ammoniacal solution of silver nitrate is reduced by carbon

monoxide. The reaction may be used for the detection of carbon monoxide in air.

HAGER (*free mineral acids in vinegar*).—Twenty c.c. of the vinegar are evaporated on the water-bath with 5 c.c. of ammonia solution. In the presence of free mineral acids, a crystalline residue will be left.

HAGER (*alkaloids*).—The reagent consists of a saturated solution of picric acid.

HAGER (*cholesterol*).—A chloroform solution of cholesterol gives a red coloration on the addition of sulphuric acid.

HAGER (*dextrose*). –Thirty grms. of red mercuric oxide, 30 grms. of sodium acetate, and 50 grms. of sodium chloride are dissolved, with the aid of gentle heat, in 25 grms. of glacial acetic acid and 400 c.c. of water, and the solution diluted to 1 litre. The mercury compound is reduced by dextrose on heating.

HAGER (*sugar in glycerin*).—Glycerin containing sugar gives an intense blue coloration when boiled with ammonium molybdate and nitric acid.

HAGER-GAWALOWSKY (*dextrose*).—The reagent consists of ammonium molybdate in neutral aqueous solution. It gives a blue coloration when boiled with dextrose in the presence of acid. The same reaction is also obtained with cane sugar.

HAINE (*dextrose*).—Copper sulphate, 3 grms.; potassium hydroxide, 9 grms.; glycerin, 100 grms.; and water, 600 c.c. When heated with dextrose the well-known red precipitate is obtained.

HALPHEN (*cotton-seed oil in olive oil*).—Equal parts of amyl alcohol and carbon bisulphide are mixed, and an excess of sulphur is added to the solution. The filtered fat, or oil, is mixed with an equal volume of the reagent, and heated for fifteen minutes to one and a half hours in a flask fitted

with a reflux condenser, and immersed in a vigorously-boiling salt-water-bath. If during this time the liquid becomes pink or red, cotton-seed oil is present.

HAMILTON (*microscopic stain*). Hæmatoxylin, 12 grms.; ammonium alum, 50 grms.; glycerin, 65 c.c.; and water, 130 c.c. These are boiled together, and 5 c.c. of melted phenol are added to the liquid.

HAMMARSTEN (*albumin*).—A violet coloration is obtained on heating a mixture of 1 part of sulphuric acid and 2 parts of acetic acid with albumin.

HAMMARSTEN (*biliary pigments*).—One part of nitric acid is mixed with 19 parts of hydrochloric acid, and the mixture allowed to stand until it becomes yellow. Before applying the test the reagent is mixed with 5 parts of 95 per cent. alcohol. In the presence of biliary pigments a green coloration is obtained.

HAMMARSTEN-JAFFÉ (*indican in urine*).—The urine is mixed with an equal volume of fuming nitric acid, a concentrated solution of calcium hypochlorite added, drop by drop, and the mixture is shaken with chloroform. Indican, when present, is extracted, and indigo, recognisable by its blue colour, is formed. In the presence of excess of hypochlorite the blue colour disappears, owing to the formation of isatin.

HANSTEIN (*stain for microscopy*). -This is a solution in strong alcohol of 1 grm. of methyl violet and 2 grms. of magenta.

HANUS (*iodine absorption*). --Iodine monobromide, prepared by slowly adding 13 grms. of bromine to 20 grms. of finely-powdered iodine and keeping the temperature below 8° C. The excess of bromine is expelled by means of carbon dioxide. The reagent consists of a solution of 10 grms. of the bromide in 500 c.c. of glacial acetic acid.

HAUCHECORNE (*foreign oils in olive oil*).—Six grms. of the oil are vigorously shaken for two minutes with 2 parts of nitric acid free from nitrogen oxides (3 parts of nitric acid of 40 Be. and 1 part of water), and a note is taken of the colour of the oil immediately after the agitation, and after the test-tube has stood for twenty minutes in boiling water. Sesamé, cotton-seed, linseed, rape oils, etc., give an orange to red-brown coloration, whilst olive and arachis oils remain nearly colourless if fresh, or become yellow to orange if rancid.

HAUSSLER (*citric acid*).—When an alcoholic solution of vanillin is allowed to evaporate spontaneously in presence of citric acid and the residue is treated with a few drops of sulphuric acid and heated, an intense green coloration is obtained, which changes to red on the addition of ammonia.

HEGLER (*lignin*).—The sections are immersed in alcohol, and then treated with a solution of thallium sulphate in dilute alcohol. Lignin assumes an orange-yellow colour, whilst cellulose and sugar remain colourless.

HEHNER (*formaldehyde in milk*).—Strong sulphuric acid is added to the milk so that the liquids do not mix, and in presence of formaldehyde a blue ring is produced at the zone of contact. This reaction is not produced by sulphuric acid free from iron. Again, if the distillate from the milk be treated with 1 drop of a solution of phenol, and poured on to the surface of strong sulphuric acid, a carmine-red will be obtained at the zone of contact. Sensitiveness = 1 : 200,000.

HELLER (*albumin in urine*).—The urine is treated with nitric acid in such a way as not to mix the two liquids. In the presence of albumin a white ring is formed at the zone of contact.

HELLER (*blood in urine*).—The urine is rendered strongly alkaline, and heated; and, in the

presence of blood, phosphates, coloured red by hæmatin, are precipitated.

HERAPATH (*quinine*). An alcoholic solution of quinine gives a crystalline precipitate when treated with 4 drops of tincture of iodine. At the ordinary temperature green plates are formed, whilst the crystals formed at 100° C. are reddish-brown, and have a polarising capacity.

HERBST (*aconitine*). On evaporating aconitine with phosphoric acid on the water-bath a violet coloration is produced.

HERMANN (*natural and artificial silk*).—(1) Artificial silk is insoluble in an alkaline copper solution containing glycerin (copper sulphate, 10 grms.; water, 100 c.c.; glycerin, 5 grms.; and sufficient potassium hydroxide to redissolve the precipitate). Natural silk is insoluble in this reagent.

(2) Artificial silk of the nitrocellulose type gives a nitric acid reaction with diphenylamine and brucine; whilst natural silk does not show this reaction.

HEYDENREICH (*foreign oils in olive oil*).—From 5 to 6 drops of the oil are made to fall on to 5 c.c. of sulphuric acid (60 Be.) in a flat-bottomed porcelain dish. Various colorations are produced at the zone of contact between the oil and the acid. Drying oils give brown to black colorations, semi-drying oils, orange to brown colorations, whilst olive oil gives no coloration.

HILGER (*albumin in urine*).—A white precipitate is formed on the addition of acetic acid and potassium ferrocyanide.

HILGER (*biliary pigments*).—These are precipitated by adding barium chloride and sulphuric acid, or by boiling the liquid with barium hydroxide. The yellow precipitate is decolorised when treated with alcohol containing a few drops of sulphuric acid, and gives a green solution.

HILGER (*malic acid*).—The reaction is based on the precipitation of metallic palladium from neutral solutions of palladium chloride by malic acid. It is quantitative.

HIRSCHSOHN (*Gurjun balsam in Copaiba balsam*).—Eight drops of the balsam are added to a mixture of 2 drops of strong sulphuric acid and 4 c.c. of acetic acid. A violet coloration indicates the presence of Gurjun balsam.

HIRSCHSOHN (*quinine and quinidine*). — When neutral solutions of the sulphate or chloride of these bases are heated with 1 drop of hydrogen peroxide and a 10 per cent. solution of copper sulphate, an intense raspberry-red coloration is produced.

HIRSCHSOHN (*aloes*).—About 10 c.c. of a 0·1 per cent. solution of aloes are treated with 1 drop of a 10 per cent. solution of copper sulphate and 1 drop of hydrogen peroxide. A red coloration is produced on heating the mixture.

HIRSCHSOHN (*cotton-seed oil*). –Five c.c. of the oil are heated for twenty minutes on the water-bath with 10 drops of a solution of 1 grm. of gold chloride in 200 c.c. of chloroform. In the presence of cotton-seed oil a red coloration is obtained.

HISTED (*nataloin*).—On dissolving this substance in strong sulphuric acid, and treating the solution with a crystal of potassium nitrate, there is produced a green coloration, changing to red and then to blue.

HLASIWETZ (*hydrocyanic acid*).—This is the well-known reaction of isopurpuric acid, which is the cause of the blood-red coloration obtained on heating a solution of an alkali cyanide with picric acid.

HOFFMANN (*aniline*).—When aniline is gently heated with fuming nitric acid the mixture becomes blue and then red, and crystals of

picric acid are deposited, with the evolution of gas.

HOFFMANN (*nitric acid*).—This is the well-known reaction with diphenylamine and strong sulphuric acid (blue coloration).

HOFFMANN (*phenol*).—An aqueous solution of phenol gives a violet coloration when treated with 1 to 2 c.c. of sulphuric acid and a crystal of potassium nitrate.

HOFFMANN (*tyrosin*).—The sediment from the urine is heated with water, and meanwhile treated with mercuric nitrate solution. In the presence of tyrosin the liquid assumes a purple-red colour and gives a red precipitate.

HOFFMANN (*ergot of rye in flour*).—Ten grms. of the flour are shaken with 20 c.c. of ether and 1 c.c. of sulphuric acid, the extract filtered, and the filtrate mixed with 0·5 grm. of sodium bicarbonate. In the presence of ergot the liquid shows a violet coloration.

HOFFMANN (*chloroform*). On heating chloroform with a few drops of aniline and alcoholic potassium hydroxide solution, the unpleasant odour of isonitrile is perceptible.

HOFFMEISTER (*leucine*). The solution is heated with mercurous nitrate, and in the presence of leucine metallic mercury is precipitated.

HÖHNEL (VON) (*lignin*).—A concentrated solution of phenol in strong hydrochloric acid gives a green coloration with lignin.

HOPPE-SEYLER (*phenol*).—The reaction consists in the blue coloration given by a section of pine-wood when moistened with hydrochloric acid in presence of phenol.

HOPPE-SEYLER (*dextrose in urine*). Five c.c. of a 0·5 per cent. solution of ortho-nitrophenyl-propionic acid in sodium hydroxide solution is heated to boiling with a few drops of the urine. In the presence of dextrose the liquid becomes

blue, owing to the formation of indigo (see BAEYER).

HOPPE-SEYLER (*carbon monoxide in blood*).—When blood is mixed with an equal volume of strong sodium hydroxide solution, it slowly gives a bright red coloration, which changes to greenish-brown.

HOPPE-SEYLER (*biliary pigments in urine*).—The urine is treated with milk of lime, the lime removed by means of carbon dioxide, and the precipitate collected and washed. On now adding to this precipitate a few c.c. of nitric acid, containing nitrous acid, characteristic colorations are produced (see GMELIN).

HOPPE-SEYLER (*xanthin*).—On mixing a little calcium chloride with sodium hydroxide, and adding a little xanthin, there is formed a green layer, changing to brown, and soon disappearing.

HORSLY (*nitric acid*).—Nitric acid gives a violet coloration when treated with pyrogallic acid and sulphuric acid.

HÜBER (*free mineral acids*).—Mineral acids produce in a solution of ammonium molybdate and potassium ferrocyanide, a reddish-brown turbidity, or a precipitate (boric and arsenic acids are exceptions).

HÜBL (VON) (*iodine absorption*).—Two solutions are prepared:—(*a*) 25 grms. of iodine in 500 c.c. of 95 per cent. alcohol; (*b*) 30 grms. of mercuric chloride in 500 c.c. of 95 per cent. alcohol. The solutions are mixed before use.

HÜFFNER (*urea*).—Freshly-prepared hypobromite (1 part of bromine + 10 of 30 per cent. sodium hydroxide solution) liberates nitrogen, which may be quantitatively estimated.

HÜHNEFELD (*blood in urine*).—The reaction is similar to that of Schönbein with guaiacum resin and oil of turpentine.

HUPPERT (*biliary pigments in urine*).—The pre-

cipitate obtained by adding milk of lime to the urine is extracted with hot alcohol containing sulphuric acid, and gives a green extract.

HUSEMANN (*hydrocyanic acid*).—This is the well-known Prussian blue reaction.

HUSEMANN (*morphine*).—When morphine is heated to 150° C. with strong sulphuric acid, and a drop of nitric acid is added, an intense violet coloration, changing to red, is obtained.

I.

IHL (*dextrose*).—Dextrose, like dextrin, decolorises a solution of methylene blue treated with sodium carbonate.

IHL (*beetroot sugar*).—(1) The sugar is boiled with a little hydrochloric acid, and, when cold, is treated with resorcinol and strong sulphuric acid. The liquid is always coloured red, and subsequently yields a red flocculent precipitate.

(2) On boiling a solution of the sugar with an alcoholic solution of orcinol and hydrochloric acid, a yellow coloration is obtained, and on diluting the liquid with water, a green precipitate is formed.

(3) The sugar solution gives a violet-red coloration on the addition of an alcoholic solution of α-naphthol and strong sulphuric acid.

ILOSVAY (*nitrous acid*).—See GRIESS.

ILOSVAY (*hydrogen peroxide*).—Five drops of dimethylaniline and 0·03 grm. of potassium bichromate are dissolved in a litre of water. On treating 5 c.c. of hydrogen peroxide with 5 c.c. of the reagent and 1 drop of 5 per cent. oxalic acid solution a yellow coloration is produced. Sensitivenss = 1 : 5,000,000.

INCE (*nitric acid*).—Five c.c. of a solution of sodium sulphophenolate are mixed with 5 c.c.

of strong sulphuric acid, and this mixture is added to the liquid under examination so that the two liquids remain separate. In the presence of nitric acid a red-brown ring is obtained. Sensitiveness = 1 : 30,000.

IPSEN (*carbon monoxide in blood*).—The blood is treated with a few drops of sodium hydroxide solution, and then with powdered dextrose. Normal blood rapidly turns brown, whilst blood containing carbon monoxide becomes bright red.

ITALLIE (VAN) (*salicylic acid*).—On heating a solution of sodium salicylate with potassium nitrite and dilute sulphuric acid a yellow coloration, changing to brown, is obtained. On adding a few drops of sodium hydrochlorite solution, there is produced a bright green coloration, which changes to red when the liquid is treated with an excess of acid.

ITTNER (*hydrocyanic acid*).—Prussian blue is formed when a solution of an alkali cyanide is treated with potassium hydroxide and an iron salt, and the liquid acidified with hydrochloric acid.

J.

JACQUEMART (*alcohol*).—A black precipitate is obtained on heating ordinary alcohol with a solution of mercuric nitrate free from mercurous salt, and then adding ammonia.

JACQUEMIN (*differentiation of silk, wool, and cotton*).—The textile under examination is treated with a tepid solution of chromic acid. Silk and woollen fibres are coloured yellow, whilst cotton fibres remain colourless.

JACQUEMIN (*phenol*).—A blue coloration is obtained on treating a solution of phenol with a little aniline and sodium hypochlorite solution.

JACQUEMIN (*aniline*).—A dilute aqueous solution of aniline gives a red coloration, soon changing to yellow, when mixed with calcium chloride solution and treated with a dilute solution of ammonium hydrosulphide.

JAFFÉ (*quinuric acid*).—The substance when evaporated to dryness on the water-bath with hydrochloric acid and potassium chlorate gives a reddish residue, which becomes emerald-green when moistened with ammonia solution.

JAFFÉ (*creatinine*).—The precipitate given by a saturated solution of picric acid becomes yellowish-red to blood-red on the addition of sodium hydroxide. Creatine does not give this reaction.

JAFFÉ (*indican in urine*).—See HAMMARSTEN.

JAFFÉ (*urobilin*).—Zinc chloride and ammonia produce a red-green fluorescence, which can be removed by extraction with isobutyl alcohol.

JAGER (DE) (*free acids in gastric juice*).—The reagent is prepared by mixing two drops of ferric chloride solution with 0·5 grm. of sodium salicylate in 100 c.c. of water. Two c.c. of this reagent are diluted with 80 per cent. of water, and treated with 10 c.c. of the gastric juice. In the presence of hydrochloric acid, or other mineral acids, the yellowish-brown colour of the reagent changes to violet-blue, and, in the presence of lactic acid, to wine-red.

JAKSCH (*hydrochloric acid in gastric juice*).—An aqueous solution of "emerald-green" changes its blue colour to green in presence of even dilute hydrochloric acid.

JAKSCH (*uric acid*).—The reaction is essentially the murexide test, with the difference that chlorine water is used in place of nitric acid.

JAKSCH (*dextrose*).—This is the well known reaction with phenylhydrazine.

JAKSCH (*melanin and melanogen in urine*).—These

two substances give a black precipitate with a dilute solution of ferric chloride, and the precipitate is soluble in potassium hydroxide solution, and in concentrated acids.

JAKSCH (*biliary pigments in blood*).—The serum separated from 15 c.c. of blood is filtered, and allowed to stand. Normal serum is of a clear yellow colour, and becomes milky; in the presence of biliary pigments the serum is green, and, on heating to 60° C., becomes grass-green.

JAQUEMIN (*urethan in urine*).—A large quantity of the urine is extracted with ether, and the residue from the ethereal solution is taken up with water, and treated with potassium hydroxide and 5 per cent. mercuric chloride solution, until the yellow precipitate, which forms, no longer redissolves. The quantity of urethan present is proportional to the amount of mercuric chloride used.

JAWOROWSKY (*albumin in urine*).—One part of ammonium molybdate and 4 parts of citric acid are dissolved in 40 parts of water, and 1 drop of this solution is added to 4 c.c. of the urine, which ought not to have an alkaline reaction. In the presence of albumin a white turbidity is formed, and does not disappear on heating.

JAWOROWSKY (*alkaloids*).—The reagent consists of a solution of 0·3 grm. of sodium vanadate in 10 c.c. of hot water, mixed with a solution of 0·3 grm. of copper sulphate in 10 c.c. of water, with the addition of a little acetic acid, to redissolve the resulting precipitate. One drop of this reagent, added to 5 c.c. of the solution of the alkaloid, gives a precipitate, especially in the case of concentrated alkaloidal solutions.

JAWOROWSKY (*chloral*).—(1) When resorcinol is dissolved in a dilute aqueous solution of chloral hydrate, and a small quantity of strong sulphuric acid is added, a brown ring is produced at the

zone of contact, and, on adding ammonia solution to this liquid, the supernatant alkaline layer becomes reddish-yellow.

(2) On heating a solution of chloral hydrate with a little phloroglucinol, and adding a little potassium hydroxide, an intense brown coloration is obtained; when the liquid is shaken with hydrochloric acid and amyl alcohol the latter takes up the brown coloration.

JAWOROWSKY (*dextrose*).—When a solution of dextrose is rendered alkaline, and boiled with a little iodic acid, and the liquid then cooled and acidified, and afterwards treated with ammonia, a brown precipitate of nitrogen iodide is obtained.

JAWOROWSKY (*guaiacol*).—One drop of guaiacol reduces an ammoniacal solution of silver nitrate, especially when heated, and a mixture of guaiacol with ammoniacal silver nitrate solution gives a red coloration after a short time, when treated with acetic acid.

JAWOROWSKY (*santonin*).—On shaking a solution of 0·02 grm. of santonin in 2 c.c. of strong sulphuric acid with a 1 per cent. solution of cerium sulphate, acidified with sulphuric acid, there is produced a cherry-red coloration, which becomes turbid on cooling, and, when diluted with 8 c.c. of water, yields a violet precipitate.

JAWOROWSKY (*copper*).—An ammoniacal solution of phenol gives a blue coloration within an hour, when added to a solution containing copper.

JOHANNSON (*alkaloids*).—The reagent consists of a solution of 1 grm. of ammonium vanadate in 100 c.c. of strong sulphuric acid. It gives the following colorations:—With atropine, reddish-yellow; brucine, blood-red; codeine, brownish-green; coniine, green; morphine, brown; papaverine, violet; pilocarpine, orange; quinidine, blue-green; quinine, first orange and then

blue-green ; and strychnine, violet-blue, changing to red.

JOHNSON (*dextrose in urine*).—The urine is treated with an excess of mercuric chloride, and filtered, and the excess of the mercury salt removed by means of ammonia. On the addition of picric acid and potassium hydroxide, the presence of dextrose is indicated by the formation of an intense red coloration, due to potassium isopurpurate.

JOLLES (*albumin in urine*).—The reagent consists of a solution of 1 grm. of mercuric chloride, 2 grms. of succinic acid, and 1 grm. of sodium chloride in 50 c.c. of water. Four c.c. of the filtered urine are introduced into two test-tubes, and acidified with 1 c.c. of acetic acid. To one portion an addition of 4 c.c. of the reagent is made, whilst the other portion is diluted with water. The tubes are shaken and compared, and the presence of albumin is shown by the formation of a white turbidity.

JOLLES (*bromine in urine*).—Ten c.c. of the urine are acidified with sulphuric acid, and treated with sufficient potassium permanganate to give a permanent pink coloration. Some strips of filter paper impregnated with a 0·1 per cent. solution of *p*-dimethyl-phenylenediamine are then introduced into the neck of the flask, and the liquid is heated. In the presence of bromine, the strips become violet in the middle, and brown at the edges.

JOLLES (*histone in urine*).—From 50 to 100 c.c. of the urine are rendered slightly acid with acetic acid, and treated with barium chloride, until a precipitate no longer forms. The liquid is then filtered, and the precipitate dissolved in 10 c.c. of 1 per cent. hydrochloric acid. After neutralisation with sodium carbonate, the solution is filtered, and the filtrate is treated, first

with hydrochloric acid, and then with ammonia. In the presence of histone a turbidity is obtained.

JOLLES (*biliary pigments in urine*).- Fifty c.c. of the urine are treated with a few drops of 10 per cent. hydrochloric acid, and then with an excess of barium chloride, and shaken with 5 c.c. of pure chloroform. After standing for ten minutes, the chloroform layer is separated, and evaporated on the water-bath at 80° C. The residue is taken up with water, and treated with 3 drops of nitric acid mixed with 1 drop of fuming nitric acid. In the presence of biliary pigments, the characteristic green coloration with blue ring is obtained.

JOLLES (*pyramidon in urine*). —The urine is treated with 1 c.c. of tincture of iodine, diluted with 10 c.c. of water, so that the liquids do not mix. In the presence of pyramidon a reddish-brown ring is produced in a short time.

JOLLES (*mercury in urine*).- One hundred c.c. of the urine are heated with 2 grms of granular gold in the presence of stannous chloride. The liquid is decanted, and the amalgam, obtained when mercury is present, is washed with water, and treated with an equal volume of a freshly-made saturated solution of stannous chloride. Traces of mercury produce a distinct turbidity.

JORISSEN (*cinnamic acid in benzoic acid*). The benzoic acid is shaken in a closed tube with a few c.c. of a 3 per cent. saturated aqueous solution of uranium acetate, and the tube is exposed to direct sunlight. In the presence of cinnamic acid, the odour of benzaldehyde will be perceived.

JORISSEN (*salicylic acid*).—The solution is heated with 5 drops of a 10 per cent. solution of potassium nitrite, followed by an equal quantity of acetic acid, and 1 drop of a 10 per cent. solution of copper sulphate. In the presence

of salicylic acid, a blood-red coloration will be produced.

JORISSEN (*nitrous acid*).—The reagent consists of a solution of 0·01 grm. of magenta in 100 c.c. of acetic acid. Nitrous acid, mixed with the reagent, gives a violet coloration, changing to violet, then to yellow, and finally disappearing.

JORISSEN (*alkaloids and glucosides*).—One grm. of zinc chloride is dissolved in 30 c.c. of strong hydrochloric acid and 30 c.c. of water, and the liquid under examination is evaporated to dryness on the water-bath with this reagent. The following colorations are produced:—Quinine, green; cubebine, carmine-red; digitaline, brown; narceine, olive-green; salicin, violet-red; santonin, violet-blue; strychnine pink; thebaine, yellow; and veratrine, red.

JORISSEN (*apiol*).—The dilute alcoholic solution is treated with chlorine water until a turbidity appears, and then, on the addition of ammonia, gives a bright red coloration, which rapidly disappears.

JORISSEN (*dulcine*).—From 1 to 2 grms. of freshly-precipitated mercuric oxide is dissolved in dilute nitric acid, and the solution is treated with sodium hydroxide until a precipitate begins to form, and then diluted with water to 15 c.c. On heating 5 c.c. of an aqueous solution of dulcine for five minutes on the water-bath with 4 drops of the reagent, a violet-blue coloration is obtained, and this changes to violet on the addition of lead peroxide.

JORISSEN (*formaldehyde*).—A few drops of formaldehyde solution are placed on a watch-glass beneath a glass bell-jar, whilst beside it is placed a porcelain crucible, containing a few crystals of morphine and 10 drops of strong sulphuric acid. The formaldehyde vapours rapidly turn the acid mixture indigo-blue.

Jorissen (*fusel oil*).—The solution, if rich in alcohol, is diluted and shaken with ether, and the ethereal extract evaporated. On treating the residue with colourless aniline and hydrochloric acid, a red coloration is obtained.

Jorissen (*morphine*).—On heating morphine with strong sulphuric acid and with a crystal of ferrous sulphate, and adding ammonia solution without mixing the two liquids, a red to violet zone is obtained, whilst the ammoniacal liquid is coloured blue.

Jorissen (*ethyl peroxide in ether*).—The reagent consists of 0·4 grm. of vanadic acid dissolved in 4 c.c. of sulphuric acid and diluted with water to 100 c.c. On shaking 2 c.c. of this reagent (which is of a greenish-blue colour) with 10 c.c. of ether, a pink to blood-red coloration is obtained, in the presence of ethyl peroxide.

Judd (*formaldehyde*).—Ten c.c. of the liquid under examination are treated with 10 c.c. of 5 per cent. sodium hydroxide solution, and 1 to 2 drops of an alcoholic solution of phloroglucinol. In the presence of formaldehyde, there is obtained, after a few minutes, a pinkish-red coloration, changing to brownish-yellow.

K.

Kastle (*saccharin*).—When saccharin is heated with phenol and strong sulphuric acid, and the mixture is diluted with a little water, and rendered alkaline with sodium hydroxide, a purple-red or pink coloration is obtained. Sensitiveness = 0·025 mgrm. of saccharin.

Katayama (*carbon monoxide in blood*).—The blood is diluted with 50 volumes of water, and 10 c.c. of the mixture are treated with 0·2 c.c of yellow ammonium sulphide, and with 0·3 c.c. of 30 per

cent. acetic acid, so as to have a slightly acid liquid. Normal blood becomes greenish-grey, whilst in the presence of carbon monoxide, a bright red coloration is obtained.

KATHREIN (*biliary pigments in urine*). —Five c.c. of the urine are treated with 5 to 10 drops of tincture of iodine. In the presence of biliary pigments, a green coloration is obtained, whilst normal urine becomes brownish-red.

KELLER (*digitonine*).—On heating 0·01 grm. of digitonine for five minutes on the water-bath with 5 c.c. of strong hydrochloric acid, the solution becomes successively yellow, red, and finally violet-blue. When diluted, after cooling, with 20 c.c. of water, a liquid with a reddish-blue fluorescence is obtained.

KELLER (*ergotinine, cornutine*).—The alkaloid, which is insoluble in ether acidified with hydrochloric acid, is dissolved in acetic acid, and the solution is made to fall drop by drop on to sulphuric acid containing ferric oxide. A blue to violet ring is produced.

KENTMANN (*formaldehyde*).—See JORISSEN.

KERNER (*quinine in urine*). —The urine is treated with mercurous nitrate and filtered, and, in the presence of quinine, the filtrate will be fluorescent. In this way, it is possible, by the use of Kerner's fluoroscope, to recognise quinine in solutions containing 1 part in 8,000,000.

KERNER (*creatinine*).—A solution of creatinine acidified with a mineral acid gives, even when very dilute, a crystalline precipitate with phosphotungstic or phosphomolybdic acid.

KERNER (*morphine*).—When 1 drop of a solution of morphine is treated with 6 drops of ferric chloride solution (1 : 8) and 3 drops of potassium ferricyanide solution (1 : 100), a blue coloration and blue precipitate are obtained.

KILIANI-KELLER (*active principles of digitalis*).—

The substance is dissolved in glacial acetic acid containing ferric sulphate, and the solution is dropped on to sulphuric acid containing ferric sulphate. Digitoxine and digitonine impart a blue colour to the glacial acetic acid, and digitaline and digitaligenine a violet-red colour, whilst digitoxigenine produces a characteristic red coloration, with pronounced fluorescence.

KIPPENBERGER (*colchicine*). — On heating an aqueous solution of colchicine with excess of an alkaline solution of hydroxylamine hydrochloride, an orange coloration is obtained.

KITASATO-SALKOWSKI (*indol*).—One c.c. of a 0·2 per cent. solution of potassium nitrite, and a little sulphuric acid, are added to 10 c.c. of the culture solution. In the presence of indol a red coloration is produced.

KLEINEMBERG (*stain for microscopy*).—This consists of 2·5 grms. of hæmatoxylin, 20 grms. of crystalline calcium chloride in 10 c.c. of water, 3 grms. of alum in 16 c.c. of water, and 240 c.c. of alcohol.

KLETT (*indican in urine*). Ten c.c. of the urine are treated with 5 c.c. of officinal hydrochloric acid and a few crystals of ammonium persulphate, and with chloroform. In the presence of indican, the chloroform becomes blue.

KLUNGE (*aloes*).—An aqueous solution of aloes gives a blue coloration on the addition of copper sulphate solution. On then adding alcohol and sodium chloride, and boiling the liquid, the colour changes to violet-red.

KLUNGE (*berberine*).—The solution, acidified with hydrochloric acid, gives a red coloration on the addition of chlorine water.

KNAPP (*glycogen*).—Glycogen precipitates metallic mercury from a hot solution of mercury cyanide. This reduction is also effected by dextrose and by creatine. Hence, Knapp suggests the use of

the method for the quantitative estimation of dextrose.

KNOP (*urea*).—See HÜFFNER.

KNORR (*antipyrin*).—Antipyrin gives a red coloration, when treated with ferric chloride.

KOBERT (*hydrocyanic acid in blood*).—The normal brown solution of methæmoglobin is turned red by hydrocyanic acid, whilst, at the same time, the spectrum of methæmoglobin gives place to the mono-striated spectrum of cyano-hæmoglobin.

KOBERT (*methæmoglobin*).—The addition of hydrocyanic acid imparts a red coloration to a neutral solution of methæmoglobin, but not to that of hæmatin.

KOBERT (*morphine derivatives*).—Sulphuric acid and formaldehyde rapidly turn dionine blue ; heroine becomes, first violet-red, and then violet-blue ; and peronine becomes permanently violet-red.

KOCH (*stain for bacteriology*).—Five c.c. of pure aniline oil are mixed with 100 c.c. of water, and the mixture is filtered after vigorous shaking. To the clear filtrate is added, drop by drop, a saturated alcoholic solution of methyl violet, or, better, of magenta (20 grms. in 100 to 150 c.c. of alcohol), until a slight opalescence is produced.

KOHN (*glycerin*).—When glycerin is heated with potassium bisulphate it produces acrolein, which restores the pink colour to a solution of magenta decolorised with sulphur dioxide (Schiff's reagent).

KOSSEL (*hypoxanthin*).—On treating the solution with zinc and hydrochloric acid, and then making it alkaline with sodium hydroxide, a ruby-red coloration, changing to brownish-red, is obtained.

KRAEMER (*saffron*).—Saffron stamens are immediately coloured blue, when treated with sulphuric acid.

KRAL (*hydrogen sulphide*).—The reagent consists of an ammoniacal solution of sodium nitroprusside,

which, in the presence of hydrogen sulphide, gives a violet coloration.

KRASSER (*proteins*).—An alcoholic solution of alloxan gives a bright red coloration on contact with solid albumin.

KRAUT (*alkaloids*).—See DRAGENDORFF.

KREHBIEL (*biliary pigments in urine*).—This is a modification of Gmelin's reaction, and consists in the use of hydrochloric acid and calcium hypochlorite as the oxidising agent.

KREIS (*cholesterol and phytosterol*).—On evaporating a few drops of an ethereal solution of cholesterol or phytosterol in a porcelain crucible, and treating the residue with 2 drops of a 20 per cent. alcoholic solution of benzaldehyde and 1 drop of strong sulphuric acid, the residue becomes, first violet-red, and then deep violet. Picrotoxine, which behaves in a similar manner, finally becomes scarlet-red.

KUBORNE (*cocaine*).—On evaporating a small quantity of cocaine to dryness with 1 c.c. of 65 per cent. nitric acid, on the water-bath, a residue is obtained, which, while cold, remains colourless after the addition of a few drops of a solution of potassium hydroxide in amyl alcohol. If, however, the mixture is again heated on the water-bath, it suddenly develops an intense violet coloration.

KÜHNE (*stain for bacteriology*).—This consists of 1·5 grms. of methylene blue, 10 c.c. of absolute alcohol, and 100 c.c. of a 5 per cent. solution of phenol. It keeps well.

KULZ (*biliary pigments in urine*).—A few drops of the urine are evaporated on the water-bath, and treated with a few drops of a solution of sugar, and 1 drop of sulphuric acid. In the presence of biliary acids, the mass, when heated, becomes violet-red at the edges.

KURT-BOAS (*adrenaline*).—On shaking 3 to 4 drops

of a 0·1 per cent. aqueous solution of adrenaline with 6 to 8 c.c. of water and a few drops of a 1 to 2 per cent. solution of mercuric chloride, a diffused brown coloration is produced after a few minutes, and persists for several days. When the liquid is heated to boiling, it immediately becomes red.

L.

Labiche (*cotton-seed oil*).—Twenty grms. of the fat are heated with the same quantity of lead acetate solution (50 grms. in 100 c.c.), and the mixture is shaken with 5 c.c. of ammonia solution, and maintained at 35° C. In the presence of cotton-seed oil, a reddish-yellow coloration is produced.

Ladendorf (*hæmoglobin*). Two c.c. of the liquid are treated with 2 drops of tincture of guaiacum, and 1 c.c. of oil of eucalyptus. In the presence of hæmoglobin, a ring is produced, which is blue below and violet above.

Lafon (*codeine*). One grm. of ammonium selenate is dissolved in 20 c.c. of pure sulphuric acid. This reagent produces with codeine a bright green coloration, which rapidly changes to brownish-red.

Lafon (*digitaline*).—One grm. of sodium tellurate, or selenate, in 20 c.c. of sulphuric acid, gives a greenish-blue coloration, when added to a solution of digitaline.

Lafon-Keller (*alkaloids*).—The reagent consists of strong sulphuric acid containing traces of iron oxide. It gives a blue coloration with morphine, codeine, and heroine; a violet coloration with apomorphine, digitaline and ergotine; and a red coloration with thebaine, narceine, and laudanine.

Lagorche (*cochineal*).—This turns green when treated with a drop of uranium acetate solution.

LAMAL (*morphine*).—To 10 drops of the solution under examination are added 10 drops of a solution of 0·3 grm. of uranium acetate and 0·2 grm. of sodium acetate in 10 c.c. of water, and the liquid is evaporated to dryness in a porcelain basin. In the presence of morphine reddish-brown or purple-red concentric rings are produced.

LAMBERT (*phenols*).—On dissolving a little iodoform (or chloroform) in a solution of a phenol, and adding potassium hydroxide, the following colorations are obtained: Ordinary phenol, resorcinol, pyrogallol, and phloroglucinol, red; salicylic acid and orcinol, reddish-violet; guaiacol and thymol, violet; and hydroquinone and the two naphthols, blue.

LANDOLT (*phenol*).—Bromine water gives with phenol a white precipitate of tribromophenol.

LANGLEY (*alkaloids*).—The reaction consists in adding to a salt of the alkaloid, potassium nitrate and sulphuric acid, and finally sodium hydroxide. Chromatic reactions are given by various alkaloids, one of the most distinctive being that of picrotoxine, which gives a deep red coloration.

LASSAIGNE (*hydrocyanic acid*). Sulphate of copper, in the presence of free sulphur dioxide, produces a turbidity or white precipitate in solutions of a cyanide.

LAUTH (*hydrogen sulphide*). Paraphenylenediamine, in slightly-acid solution, forms Lauth's violet, when treated with ferric chloride in presence of hydrogen sulphide. If, however, the sulphate of *p*-amino-dimethylaniline is used, methylene blue is produced (see CARO FISCHER).

LAVE (*veratrine*).—The reagent is prepared by mixing 4 drops of a 1 per cent. aqueous solution of furfural with 1 c.c. of sulphuric acid. From 4 to 5 drops of the reagent are added to the substance under examination in such a way that it

remains on the surface. In the presence of veratrine, there is produced a pronounced streak, which is first green, then blue, and finally violet. If the liquid be shaken, it becomes deep green, and, after a short time, especially when heated, violet-blue.

LEBLIN (*formaldehyde*).—The reagent consists of a solution of resorcinol in sodium hydroxide solution. When the reagent is heated for half a minute with formaldehyde, an intense red coloration is produced. Proteins interfere with the reaction.

LECHINI (*blood in urine*).—Ten c.c. of the urine are treated with 1 drop of acetic acid and 3 c.c. of chloroform. In the presence of blood, the chloroform layer becomes red.

LEGAL (*acetone in urine*).—The distillate from the urine is treated with 10 drops of a 10 per cent. solution of sodium nitroprusside, and then with 2 drops of potassium or sodium hydroxide solution. In the presence of acetone, an intense red coloration is produced. The reaction is intensified by adding a few drops of acetic acid.

LEGAL (*indol*).—The solution is treated with sodium nitroprusside until yellow, and on now adding a few drops of dilute sodium hydroxide solution, it produces a magnificent violet coloration, which changes to green on the addition of acids.

LEGER (*chrysophanic acid and chrysarobine*).—(1) On treating a trace of chrysophanic acid with 1 c.c. of strong sulphuric acid, a strawberry-red coloration is obtained. Chrysarobine, under the same conditions, gives an orange coloration.

(2) When chrysophanic acid is ground up with alcohol, and then treated with 20 c.c. of water containing 5 drops of sodium hydroxide solution (35° Be.), it immediately dissolves, and gives a strawberry-red coloration. Chrysarobine,

under the same conditions, dissolves slowly and gives a pale rose coloration.

LEGER (*α- and β-naphthol*).—To 10 c.c. of a cold saturated solution of naphthol are added 2 drops of sodium hypobromite solution. In the presence of *α*-naphthol, the liquid becomes deep red, whilst *β*-naphthol gives a yellow coloration, which changes to green, and then to yellow.

LEHMANN (*dextrose*).—On treating an alcoholic solution of dextrose with alcoholic potassium hydroxide solution, and then with copper sulphate solution, and heating the liquid, cuprous oxide separates.

LEISMER (*dextrose in urine*).—Two c.c. of the urine are boiled with 2 c.c. of sodium hydroxide solution, and 5 c.c. of a 0·1 per cent. solution of safranine. In the presence of dextrose, the liquid is decolorised.

LE-NOBLE (*acetone in urine*).—See LEGAL.

LE-NOBLE (*biliary pigments*).—A dichroic spectrum is obtained on treating the solution with zinc chloride and tincture of iodine.

LENZ (*pilocarpine*).—On treating pilocarpine hydrochloride with mercurous chloride, reduction takes place, with the formation of a black coloration. Darkening of the liquid, though less intense, also occurs with cocaine hydrochloride (Schell), and with stovaine and alipine (Zernick).

LEPAGE (*alkaloids*).—The reagent is similar to that of Marmé.

LETHEBY (*aniline*).—A blue coloration is obtained on heating aniline to 50° C. with manganese dioxide and dilute sulphuric acid.

LEX (*phenol*).—On treating an aqueous solution of phenol with an alkali nitrite and sulphuric acid, and then adding sodium hydroxide, a brown coloration is obtained; and on then adding calcium hypochlorite, the colour changes to blue.

LEWIN (*sesamé oil in olive oil*).—This is a modification of Baudouin's reaction. Two c.c. of the oil are poured on to 0·5 grm. of powdered sugar, and 1 c.c. of hydrochloric acid (sp. gr. = 1·18) is poured down the side of the tube. In the presence of sesamé oil, a pink zone appears, after about five minutes, at the point of contact.

LEYS (*saccharin*).—Two solutions are prepared, one containing 2 c.c. of ferric chloride solution (30° Be.) in 100 c.c. of water, and the other 1 c.c. of hydrogen peroxide (10 volumes) in 200 c.c. of water. On treating 5 c.c. of a saccharin solution with 2 drops of the ferric chloride solution, and 2 c.c. of the hydrogen peroxide solution, a violet coloration is produced after thirty to forty-five minutes.

LIEBEN (*acetone in urine*).—The distillate from urine containing acetone forms iodoform, on the addition of potassium hydroxide and iodine.

LIEBERMANN (*cholesterol*).—On treating a solution of cholesterol in acetic anhydride with strong sulphuric acid, a pink coloration, changing rapidly to intense blue and to green, is obtained. The reaction is rendered more sensitive by using chloroform in place of acetic anhydride. Sensitiveness = 1 : 20,000.

LIEBERMANN (*phenols*).—On treating phenols with a small quantity of a reagent consisting of 0·5 parts of potassium nitrate in 100 c.c. of sulphuric acid, various colorations are produced, which change to blue on neutralising the liquid with potassium hydroxide.

LIEBERMANN (*ethyl sulphide in urine*).—Eight grms. of potassium nitrite are dissolved in 100 grms. of strong sulphuric acid diluted with 6 to 7 c.c. of water, and the solution is filtered through glass wool. In the presence of ethyl sulphide, this reagent produces a fugitive green coloration.

LIEBERMANN (*proteins*).—The substance is washed

with alcohol, and treated with concentrated hydrochloric acid. In the presence of proteins, a fine violet-blue coloration is obtained.

LIEBIG (*hydrocyanic acid*).—On evaporating hydrocyanic acid with ammonium sulphide, a residue is left, which becomes blood-red on the addition of ferric chloride previously acidified with hydrochloric acid (ferric thiocyanate).

LIEBIG (*cystine*).—When cystine is boiled with sodium hydroxide solution containing lead oxide, a black coloration, due to the formation of lead sulphide, is obtained.

LIEBIG (*urea*).—Urea forms a white precipitate with mercurous nitrate. The reaction is quantitative.

LINDO (*nitrates and nitrites*).—On mixing 0·5 c.c. of a solution of either of these salts with 1 drop of hydrochloric acid (15 per cent.), 1 drop of a 10 per cent. solution of resorcinol, and 2 c.c. of pure sulphuric acid, a purple-red coloration is obtained.

LINDO (*saccharin*).—The residue left on evaporating a solution of saccharin in nitric acid gives, when treated with a 50 per cent. alcoholic solution of potassium hydroxide, a coloration, which is first blue, then violet, and finally purple-red.

LÖFFLER (*stain for bacteriology*).—This consists of 30 c.c. of a saturated alcoholic solution of methylene blue, and 100 c.c. of a solution of potassium hydroxide (1 : 10,000).

LONGI (*nitric acid*).—The reagent is an aqueous solution of paratoluidine sulphate. On adding a few drops thereof to the liquid under examination, and then an equal volume of strong sulphuric acid, there is produced, in the presence of nitric acid, a red zone, which changes to dark yellow.

LOUBIOU (*indican in urine*).—Two c.c. of the urine are treated with an equal volume of chloroform,

and with 1 c.c. of 5 to 10 per cent. hydrogen peroxide. Then, after the addition of 2 drops of strong hydrochloric acid, the liquid is slightly heated, and shaken. In the presence of indican, the chloroform becomes blue.

LÖWE (*dextrose*).—A solution of copper sulphate (16 grms. in 150 c.c. of water) is mixed with glycerin (sp. gr. 1·8), and sodium hydroxide is added, until the precipitate first formed is redissolved. Dextrose gives the usual red precipitate on heating.

LÖWE (*natural and artificial silk*).—The preceding reagent dissolves natural, but not artificial silk.

LÖWENTHAL (*dextrose in urine*).—The reagent consists of 60 grms. of tartaric acid, 240 grms. of potassium carbonate, and 5 grms. of crystalline ferric chloride, dissolved in 500 c.c. of water and filtered. If urine gives a brown precipitate when boiled with this reagent, dextrose is present.

LUCHINI (*alkaloids*).—The reagent consists of a hot recently-prepared solution of potassium bichromate in strong sulphuric acid. Characteristic colorations are produced when different alkaloids are treated with this reagent.

LÜCKE (*hippuric acid*).—On heating hippuric acid with strong nitric acid, and then evaporating the liquid to dryness, a residue emitting a strong odour of nitrobenzene is left.

LUGOL (*albumin in urine*).—One part of Lugol's reagent (1 of iodine and 2 of potassium iodide in 20 parts of water), when mixed with 4 parts of water and 5 parts of acetic acid, forms a solution which precipitates albumin.

LÜNGE-WOLFF (*nitrous acid*).—See GRIESS.

LUSTGARTEN (*iodoform*).—A solution of 0·1 grm. of resorcinol in 5 c.c. of alcohol is treated with a fragment of metallic sodium. On mixing 5 drops of this reagent with an ethereal solution of

iodoform, and heating the liquid carefully until the ether has been removed, a cherry-red coloration is produced.

M.

MABEN (*almond oil*).—Ten drops of the oil are shaken with 5 drops of a saturated solution of zinc chloride. Almond oil gives no coloration, but peach or apricot oils give a brownish-red coloration.

MACMUNN (*indican in urine*).—Equal parts of the urine and hydrochloric acid are boiled with 2 drops of nitric acid, and the liquid cooled, and shaken with chloroform. In the presence of indican, the chloroform assumes a violet colour, and shows a characteristic spectrum with two absorption bands.

MACWILLIAM (*albumin in urine*).—The urine under examination is shaken for a few minutes with a few crystals of sulphosalicylic acid. In the presence of albumin, a flocculent precipitate is obtained.

MALAQUIN (*strychnine*).—One c.c. of the solution is mixed with 1 c.c. of pure hydrochloric acid, and treated with 1 grm. of pure zinc, and then, after four minutes, it is rapidly heated to boiling, and cooled. On now pouring this liquid down the sides of a tube containing 2 c.c. of pure sulphuric acid, a pink coloration is obtained at the zone of contact, and rapidly diffuses into all the liquid, when strychnine is present.

MALERBA (*acetone*).—A solution of dimethylparaphenylenediamine gives a red coloration with acetone.

MANCHOT-KAMPESCHULTE (*ozone*).—When a piece of silver foil is heated to about 400° C., and brought into contact with ozone, bright bluish spots with violet edges soon appear. In the cold,

this reaction does not take place if the silver is pure ; but if the silver foil is first rubbed with emery paper, the reaction takes place, even in the cold. This reaction is not given by hydrogen peroxide.

MANDELIN (*alkaloids*).—The reagent consists of a solution of 1 grm. of ammonium vanadate in 200 grms. of strong sulphuric acid. With this reagent morphine gives a violet, and then bright blue coloration ; codeine and colchicine, green-blue ; narceine, violet and then orange ; strychnine, violet-blue and then red ; and colocynthine and veratrine, a blood-red coloration.

MANGINI (*alkaloids*).—The reagent is prepared by heating 3 grms. of potassium iodide and 16 grms. of bismuth iodide with 3 grms. of hydrochloric acid. It gives brown precipitates with solutions of alkaloidal salts.

MANKIEWICZ (*albumin in urine*). — See MACWILLIAM.

MANN (*citric acid*). When citric acid is heated with its own weight of glycerin until the mixture has solidified, the mass dissolved in hot ammonia solution, and the solution concentrated by exposure to the air for a few hours, there is produced a green coloration, which becomes more intense on the addition of hydrogen peroxide.

MANSEAU (*nitrous acid*).—A few c.c. of the liquid under examination are mixed with 2 to 5 c.c. of a 5 per cent. solution of antipyrin, and then shaken with 1 drop of sulphuric acid. In the presence of nitrous acid, a green or bluish-green coloration is produced.

MARECHAL (*biliary pigments in urine*).—On treating acid or neutral urine containing biliary pigments with 3 drops of tincture of iodine, an emerald-green coloration is produced (see SMITH).

MARMÉ (*alkaloids*).—The reagent is prepared by saturating a boiling concentrated solution of

potassium iodide (4 parts in 12 parts of water) with cadmium iodide, and then adding an equal volume of a cold saturated solution of potassium iodide. This reagent gives yellowish-white precipitates with the salts of alkaloids.

MARQUE (*sparteine*).—When sparteine sulphate is slightly heated in a crucible with a third of its weight of chromic acid, the mass becomes green, and emits an odour of cicutine.

MARQUIS (*alkaloids*).—The reagent consists of a mixture of 3 c.c. of strong sulphuric acid with 3 drops of 35 per cent. formaldehyde solution. Treated with this reagent, morphine gives a purple-red coloration, changing to violet and then to blue; the same colorations are also produced by codeine, dionine, and heroine.

MARSH (*arsenic*).—This is the well-known test, depending on the formation of arsine, when arsenical compounds are treated with nascent hydrogen, and the decomposition of the arsine by heat with liberation of free arsenic, which is deposited as a ring or as dark spots within a tube.

MATHIEU-PLESSY (*sugars*).—A fused mixture of 54 grms. of ammonium nitrate, 34 grms. of lead nitrate, and 21 grms. of lead hydroxide gives a red coloration with dextrose, and a greenish-brown coloration with sucrose.

MAUMENÉ (*dextrose*).—On heating a solution of dextrose with a 38 per cent. solution of stannous chloride, it darkens, and yields a black precipitate.

MAYER (*alkaloids*).—The reagent is prepared by dissolving 13·55 grms. of mercuric chloride, and 50 grms. of potassium iodide in a litre of water. It gives white precipitates with most alkaloids in faintly-acid solution.

MECKE (*alkaloids*).—The reagent consists of a solution of selenious acid in strong sulphuric

acid (1 : 200). It gives various coloured reactions with alkaloids, such as, for example :—Codeine, blue coloration in the cold, changing to emerald-green ; morphine, blue and then olive-green ; narceine, greenish-yellow ; and papaverine, dark blue and then violet ; saponine from guaiacum bark gives a magnificent violet coloration in this test.

MEHU (*albumin in urine*).—A mixture of 1 part of phenol, 1 of acetic acid, 2 of alcohol, and 2 of the urine, which has been previously treated with nitric acid, gives a precipitate, when albumin is present.

MELZER (*coniine and nicotine*).—An alcoholic solution of coniine gives a brown coloration, when treated with a few drops of carbon bisulphide, and then, after a few seconds, with a solution of copper sulphate (1 : 200). Nicotine, under the same conditions, gives a yellow coloration. On dissolving 1 drop of nicotine in 2 to 3 c.c. of epichlorhydrin, and heating the solution to boiling, there is produced a pronounced red coloration.

MELZER (*phenol*).—When 1 c.c. of an aqueous solution of phenol is heated with 2 c.c. of strong sulphuric acid and a few drops of benzaldehyde, a brownish-yellow mass is obtained, which becomes deep red on heating. After cooling, 10 c.c. of water are added, and the liquid rendered alkaline with 20 per cent. potassium hydroxide solution. A fine bluish-violet coloration is produced, the colouring matter being soluble in ether.

MELZER (*picrotoxine, cholesterol, phytosterol*).—On treating a trace of the substance with 1 drop of a 20 per cent. solution of benzaldehyde, and then with a drop of strong sulphuric acid, a violet-red coloration is produced.

MELZER (*alkaloids*).—The alkaloid is treated in a

porcelain crucible, first with a drop of a 20 per cent. solution of benzaldehyde in absolute alcohol, and then with a drop of sulphuric acid. Digitaline gives a brownish-yellow coloration ; veratrine, red ; codeine, yellow or blood-red ; thebaine, brown spots ; and morphine, red streaks.

MERCH (*alcohol*).—The reagent is prepared by dissolving molybdic acid in strong hot sulphuric acid, and this solution is added to the liquid under examination, which has been heated to 60° C. In the presence of alcohol, a blue ring is formed at the zone of contact.

MESSINGER (*acetone in urine*).—The distillate from urine containing acetone yields iodoform, when treated with potassium hydroxide and iodine.

METZGER (*cocaine*).—On treating an aqueous solution of a salt of cocaine with potassium chromate, and then acidifying the liquid with hydrochloric acid, an orange-yellow precipitate is produced.

MEYER (*thiophen*).—Thiophen gives a blue coloration, when treated with a solution of isatin in strong sulphuric acid.

MILLIAU (*cotton-seed oil in olive oil*). —The free fatty acids are separated from the oil under examination, and dissolved in 20 c.c. of 90 per cent. alcohol, and the solution is treated with 2 c.c. of a 3 per cent. alcoholic solution of silver nitrate. On heating the mixture to 90° C., a brown coloration indicates the presence of cotton-seed oil.

MILLON (*phenols*).—One part of mercury is dissolved in 1 part of nitric acid (sp. gr. 1·40), with the aid of gentle heat, and the solution is diluted with 2 parts of water. Should the reagent become weak after keeping, a few crystals of potassium nitrate are added. This reagent gives a red coloration and red precipitate with various phenols. Substances with a phenolic function, such as certain proteins, also behave in the same way.

MINOWIC (*picrotoxine*).—On treating a few drops of a solution of picrotoxine with 2 drops of sulphuric acid, and then, after a few minutes, adding 1 drop of a 20 per cent. solution of anisic aldehyde in absolute alcohol, a saffron-yellow coloration is obtained when the sulphuric acid is added, whilst the addition of the aldehyde produces an indigo-violet zone, the colour of which changes to blue.

MITCHELL (*formaldehyde*).—(1) On treating a solution containing formaldehyde with 1 c.c. of nitric acid and 1 c.c. of potassium bichromate solution, a blue coloration is obtained.

(2) Nessler's reagent gives a precipitate with solutions of formaldehyde.

MITCHELL (*fruit acids, vanadates*).—On heating a 1 per cent. solution of ammonium metavanadate with oxalic acid, the vanadium compound is reduced, and a blue solution obtained. Tartaric and citric acids, and to a less extent, malic acid, cause a similar reduction. Conversely, the test may be used for distinguishing between chromates and vanadates.

MOER (VAN) (*cytiscine*).—When treated with a mixture of 5 per cent. ferric chloride solution and 0·05 per cent. hydrogen peroxide solution, cytiscine gives a red coloration, changing to blue.

MOERCK (*vanillin*).—On treating a solution of vanillin with a few drops of bromine water until the odour of bromine is perceptible, and then adding a few drops of a freshly-prepared solution of ferrous sulphate, a green coloration is produced.

MOHLER (*tartaric acid*).—One grm. of resorcinol is dissolved in 1·00 grms. of sulphuric acid (sp. gr. 1·84), and 1 c.c. of the solution is heated to 125° to 130° C. with the substance under examination. In the presence of tartaric acid, a red coloration is obtained.

MOHR (*hydrochloric acid in gastric juice*).—A 5 per

cent. solution of iron acetate is diluted until it is of only a light yellow colour, and is then treated with a few drops of a 10 per cent. solution of potassium thiocyanate, which ought not to change the colour. On adding to this reagent the filtrate from the gastric juice, an intense blood-red coloration will be obtained, in the presence of free hydrochloric acid.

MOLISCH (*cellulose*).—A 15 to 20 per cent. alcoholic solution of thymol, diluted, filtered, and treated with potassium chloride, gives a blue coloration on contact with cellulose.

MOLISCH (*sugars*).—One c.c. of the liquid under examination is treated with 2 drops of a 15 to 20 per cent. alcoholic solution of α-naphthol, and then with 1 c.c. of sulphuric acid, and the mixture again shaken. In the presence of sugars, a violet coloration is produced, and on adding water there is formed a violet-blue precipitate, which dissolves in alcohol and ether, yielding a slightly yellow solution.

MOLLE (*veronal*).—A saturated aqueous solution of veronal, when treated with nitric acid and a little of Millon's reagent, gives a gelatinous white precipitate soluble in excess of the reagent.

MONPURGO (*dulcine*).—The dulcine is extracted with alcohol and ether, and the residue from the extract is heated with a mixture of 2 drops of pure phenol and 2 drops of strong sulphuric acid. The liquid, which will be of a bright red colour, is cooled, diluted with water, and cautiously added to a solution of ammonia or sodium hydroxide. A characteristic violet or blue coloration will be produced at the zone of contact.

MOORE (*dextrose*).—When a solution of dextrose is heated with potassium hydroxide it gives a yellow and then a brown coloration, and on adding excess of an acid an odour of caramel is produced.

MULDER (*proteins*).—Proteins treated with strong nitric acid give a lemon-yellow coloration, due to the formation of xantho-protein. The colour is changed to orange by alkalies.

MULDER (*dextrose*).—When a solution containing dextrose is heated with a solution of indigo sulphate, which has been neutralised with sodium hydroxide, the indigo dyestuff is reduced, and changed to green, and then to red and yellow, but on exposure to the air regains its blue colour.

MÜLLER (*cystine in urine*).—When cystine, obtained from the sediments of urine, is dissolved in hot potassium hydroxide solution, and the solution diluted with water, and treated with sodium nitroprusside, a purple-violet coloration is produced.

MULLIKEN-SCUDDER (*methyl alcohol*).—A spiral of copper wire is immersed several times in the methyl alcohol, and to the solution thus oxidised is added a 5 per cent. aqueous solution of resorcinol, and the mixture is poured on to the surface of strong sulphuric acid. At the zone of contact of the two liquids a red ring appears, and, after standing for some time, a purple-red flocculent precipitate separates.

MUSSI (*benzanilide*).—On treating a liquid containing benzanilide with a few drops of sulphuric acid, cooling the mixture, and shaking it with ether, then adding a few drops of potassium bichromate solution, and repeating the shaking, the upper layer will be ultramarine-blue and the lower emerald-green.

MYLIUS (*biliary acids in urine*).—One drop of a solution of furfural and 1 c.c. of strong sulphuric acid are added to an alcoholic solution of the supposed biliary acids, and the mixture is cooled. In the presence of biliary acids, there is formed red coloration, which does not disappear for a

considerable time, but changes to violet blue after twenty-four hours (see PETTENKOFER, UDRANSKY).

N.

NEEBAUER (*biliary acids in urine*).—A few drops of the urine are evaporated on the water-bath, and the residue is treated with 1 drop of a solution of sugar (1 : 50), and then with a drop of strong sulphuric acid, and again heated on the water-bath. In the presence of biliary acids, a violet-red ring is formed on the sides of the crucible.

NEEBAUER (*chloroform in urine*).—A current of air is passed through the urine, and then through a tube, heated to redness, into a solution of silver nitrate. If the urine contained chloroform, a precipitate of silver chloride will be obtained.

NENCKI (*indol*).—Indol gives with nitric acid containing nitrogen oxides a pronounced red coloration, and, in the case of concentrated solutions, may also yield a red precipitate.

NESSLER (*ammonia*).—Six grms. of mercuric chloride are dissolved in 50 c.c. of water, and the solution mixed with a solution of 7·4 grms. of potassium iodide in 50 c.c. of water. The liquid is cooled, and decanted from the precipitate, which is washed three times by decantation with 20 c.c. of water. It is then treated with 5 grms. of potassium iodide and a little water, which dissolve the mercuric iodide. The solution thus obtained is treated with a solution of 20 grms. of sodium hydroxide in a little water, and, after cooling, the liquid is diluted with water to 100 c.c. This reagent gives with ammonia or ammonium salts an intense yellow coloration, whilst with large quantities of ammonia it gives a brown precipitate.

NESSLER (*aldehydes*).—The reagent, prepared as

described above, or, better, a solution of mercuric iodide in potassium iodide solution to which baryta water has been added, may be used for the detection of aldehydes. With these it forms a yellowish-white or brownish-red to black precipitate, according to the quantity of aldehyde present.

NEUBAUER-VOGEL (*dextrose*).—This is identical with Fehling's reagent.

NEUBERG (*formaldehyde*).—The reagent consists of an aqueous solution of the chloride of *p*-dihydrodiphenylazine, which gives a yellow coloration when heated with formaldehyde.

NEUHAUS (*santonine in urine*).—The urine becomes violet-red when treated with Fehling's solution, and, on the addition of acetic acid, the colour changes to bright green.

NICKEL (*phloridzine*).—On boiling the substance with a large quantity of potassium nitrite and zinc sulphate, a violet-blue coloration is obtained.

NICKEL (*vanillin*).—Vanillin gives a violet coloration, when heated with potassium nitrite and mercuric chloride.

NICKLES (*peach-kernel oil in almond oil*).—Twelve grms. of the oil are vigorously shaken with 1·5 grms. of powdered slaked lime, and the mixture is heated for fifteen minutes on the water-bath, and filtered while hot. The filtrate remains clear after cooling in the case of pure almond oil, but becomes opalescent if peach-kernel or apricot-kernel oils are present.

NICOLLE (*stain for microscopy*).—The solution consists of 100 c.c. of a saturated solution of thionine in 50 per cent. alcohol, with 10 c.c. of a 1 per cent. solution of phenol.

NICOLLE-MORAN (*stain for bacteriology*).—Five grms. of pure tannin are mixed with 20 c.c. of water, 10 c.c. of a cold saturated solution of ferrous sulphate, and 2 c.c. of a saturated solution of

magenta in absolute alcohol. The liquid is filtered after two to three days.

NYLANDER (*dextrose in urine*).—This is the same as Böttger's reagent. It consists of a solution of 2 parts of bismuth subnitrate, 4 parts of potassium sodium tartrate, and 100 parts of 8 per cent. sodium hydroxide. Urine containing dextrose becomes black, or gives a black precipitate with this reagent.

O.

OBERMAYER (*indican in urine*).—The urine is treated with lead acetate, and decanted, and then treated with strong hydrochloric acid and 2 per cent. ferric chloride solution. In the presence of indican, a blue coloration is obtained, and the colour can be extracted with chloroform.

OBERMÜLLER (*cholesterol*).—When cholesterol is just melted with propionic anhydride it gives, on cooling, a violet coloration, which changes to blue, then to green, orange, and finally red.

OFFER (*uric acid*).—A liquid containing uric acid immediately gives a brilliant blue precipitate when treated with a few drops of phosphomolybdic acid, and then with a few drops of potassium hydroxide.

OGLIARO (*picrotoxine*).—A solution of picrotoxine in strong sulphuric acid gives a saffron-yellow coloration, which changes to green on the addition of potassium bichromate.

OGSTON (*chloral hydrate*).—A solution of chloral hydrate gives a brown to brownish-red coloration, and then a brown precipitate, when heated with ammonium sulphide.

ORLOW (*lecithin*).—An alcoholic solution of lecithin and alloxan becomes first pink and then red, and finally gives a red precipitate.

ORLOW-HORST (*alkaloids*).—The reagent consists of

a solution of ammonium persulphate in sulphuric acid. It gives distinctive colorations with various alkaloids. Thus, it gives an orange coloration with morphine; orange-red with narcotine; violet, blood-red, and finally yellow with narceine; and green and then blue with apomorphine.

Ost (*dextrose*).—The reagent consists of copper sulphate, 23·5 grms.; sodium carbonate, 250 grms.; and potassium carbonate, 100 grms., in a litre of water (see Soldaini, Fehling).

Osterag-Arnold (*fresh and boiled milk*).—The milk is treated with 10 per cent. of a freshly-prepared tincture of guaiacum. Fresh unboiled milk gives a blue coloration, whilst boiled milk shows a yellow tint.

Otto (*morphine*).—When morphine is treated with dilute hydrochloric acid, and then with ferric chloride and potassium ferricyanide, it gives a precipitate of Prussian blue.

Otto (*picrotoxine*).—When picrotoxine is dissolved in strong sulphuric acid it gives a yellow solution, and, on heating, is carbonised.

Otto (*strychnine*).—The substance is mixed with a few drops of a dilute solution of potassium bichromate, and a glass rod, after being dipped into the liquid, is brought into contact with strong sulphuric acid in a porcelain basin. In the presence of strychnine, blue streaks are produced.

Oudrejovich (*aceto-acetic acid in urine*).—When 5 c.c. of urine are acidified with 5 drops of 50 per cent. aceto-acetic acid, and a sufficient quantity of a 0·2 per cent. solution of methylene-blue to give a pronounced blue coloration is added, and then 4 drops of tincture of iodine, so that the liquid becomes red, the presence of aceto-acetic acid is indicated by the liquid becoming blue again after a minute, and then green.

OVERBECH (*wool fibres*).—On impregnating the fibres with a 10 per cent. aqueous solution of alloxan and treating them, after draining off the excess of liquid, with gaseous ammonia, a carmine-red coloration is obtained.

P.

PACINI (*solution for microscopy*).—This consists of 2 grms. of mercuric chloride, 4 grms. of sodium chloride, 26 grms. of glycerin, and 226 c.c. of water. For use, 1 part of the solution is diluted with 3 parts of water.

PAGEL (*cobalt salts*).—This is Vogel's reaction (see VOGEL) with potassium thiocyanate and ether.

PAGENSTECKER (*copper salts*).—One c.c. of cherry-laurel water and 10 drops of 10 per cent. guaiacum tincture are mixed in a porcelain crucible, and the solution to be tested is added. In the presence of copper salts, a blue coloration is immediately produced.

PANUM (*albumin in urine*).—The urine is rendered strongly acid with acetic acid, and mixed with an equal volume of a saturated solution of sodium chloride and sodium sulphate. In the presence of albumin, a precipitate is obtained.

PAPPENHEIM (*stain for microscopy*).—Two solutions are prepared:—(1) Liquid phenol, 0·25 grm.; water, 100 c.c.; methyl green, 1 grm. (2) Phenol, 0·25 grm.; pyronine, 1 grm.; and water, 100 c.c.

PAUL (*biliary pigments in urine*).—Normal urine, when treated with methyl violet, does not affect the colour of the dyestuff, whereas, in the presence of biliary pigments, the violet coloration changes to blood-red.

PAVY (*dextrose in urine*).—120 c.c. of Fehling's solution are diluted with water to 1,000 c.c., and 300 c.c. of ammonia solution (sp. gr. 0·88) and

400 c.c. of sodium hydroxide solution (sp. gr. 1·14) are added. On boiling the reagent with a solution containing dextrose, it is decolorised.

PAYEN (*mineral acids in vinegar*).—100 c.c. of the vinegar are boiled for thirty minutes with 0·05 grm. of starch. After cooling, the liquid is treated with a potassium iodide solution of iodine. In the presence of mineral acids, no blue coloration appears.

PELIGOT (*textile fibres*).—See SCHWEITZER.

PELLAGRI (*morphine*).—On evaporating a solution of morphine in strong hydrochloric acid with 2 drops of sulphuric acid, a purple-red coloration is produced.

PELLAGRI (*codeine*).—The solution of the substance in 0·5 c.c. of strong hydrochloric acid is heated on the water-bath with 3 drops of sulphuric acid, until the hydrochloric acid has been expelled. After being heated for fifteen minutes, the residue, which is of a violet colour, is dissolved in 2 c.c. of water, and the solution treated with a few drops of hydrochloric acid, then neutralised with sodium bicarbonate, and treated with 3 drops of tincture of iodine. An emerald-green coloration is obtained, and, on shaking the liquid with ether, the ethereal layer becomes red, whilst the aqueous layer remains green.

PELOUZE (*dextrose*).—See MOORE.

PENOT (*oils*).—The reaction consists in treating 10 c.c. of the oil with 1 grm. of a mixture of potassium bichromate and sulphuric acid. Various colorations are produced.

PENTZOLD (*acetone in urine*).—The urine is acidified and distilled, and the distillate is added to an aqueous solution of ortho-nitrobenzaldehyde, which is then made alkaline with sodium hydroxide. In the presence of acetone, a yellow coloration, changing to green, is obtained, whilst

indigo is deposited, and may be extracted with chloroform.

PENTZOLD (*dextrose*).—One part of diazo-benzene-sulphonic acid is dissolved in 60 parts of water, and the solution is rendered alkaline with 2 drops of potassium hydroxide solution. This reagent is added to an equal volume of the liquid under examination, which has been made strongly alkaline, and the mixture is allowed to stand. In the presence of dextrose, it becomes yellowish-red or bright red, and the colour then changes to dark red. The red colours show bluish reflections.

PENTZOLD (*naphthalene in urine*).—One c.c. of strong sulphuric acid is dropped on to the urine. If naphthalene is present, the urine above the acid layer becomes green, whilst, subsequently, the acid also assumes the same colour.

PENTZOLD-FISCHER (*phenol*). — On treating a strongly-alkaline solution of phenol with diazo-benzenesulphonic acid, a red coloration is obtained.

PERTUSI-GASTALDI (*hydrocyanic acid*).—The reagent consists of 1 drop of copper acetate solution, 5 drops of a saturated solution of benzidine acetate, and 0·5 c.c. of water. When hydrocyanic acid is passed through this liquid, a bright blue coloration is produced. The reaction is capable of detecting 0·000007 grm. of hydrocyanic acid in the form of an alkali cyanide in 10 c.c. of water.

PESCI (*alkaloids*).—The solution to be tested for alkaloids is treated with a reagent consisting of a mixture of solutions of copper sulphate and sodium thiosulphate, and is then acidified with dilute sulphuric acid.

PETRI (*proteins*).—On treating a solution of a protein with a solution of diazo-benzenesulphonic acid, a faint yellow coloration is produced.

When the liquid is then made alkaline, it becomes orange-yellow to brown, and, on shaking, gives a red froth.

PETTENKOFER (*biliary acids in urine*).—A small quantity of the bile substance is dissolved in hot strong sulphuric acid, or the liquid containing the biliary acids (*e.g.*, urine) is mixed with strong sulphuric acid, the temperature not being allowed to exceed 60° to 70° C. in either case. A 10 per cent. solution of cane sugar is then added, drop by drop, with constant stirring. In the presence of biliary acids, a bright red coloration is produced, which persists for a considerable time, and becomes violet after twenty-four hours. The red liquid shows a spectrum with two characteristic absorption bands.

PICK (*stain for bacteriology*).—This consists of 8 drops of Ziehl's carbolic magenta, 8 drops of a concentrated alcoholic solution of methylene-blue, and 20 c.c. of water.

PILHASTRY (*formaldehyde*).—On mixing 1 c.c. of a solution of formaldehyde with 2 drops of a reagent consisting of a solution of 1 grm. of phenylhydrazine hydrochloride and 1·5 c.c. of sodium acetate solution in 100 c.c. of water, and adding 2 drops of sulphuric acid, a green coloration is obtained.

PINETTE-SCHMIDT (*saccharin*).—The residue obtained by evaporating an ethereal extract of saccharin from the substance, is mixed with sodium hydroxide, and heated for thirty minutes at 250° C. The product is dissolved in water, acidified with sulphuric acid, and shaken with chloroform, or with ether. The extract is separated, the solvent evaporated, and the residue taken up with a little water, and treated with a dilute solution of ferric chloride. In the presence of saccharin, a violet coloration (formation of salicylic acid) will be produced.

PIOTROWSKI (*proteins*).—On heating the solution with an excess of sodium hydroxide solution and 1 to 2 drops of a dilute solution of copper sulphate, a violet coloration will be produced (biuret reaction).

PIRIA-STAEDELER (*tyrosin*).—The tyrosin is dissolved in cold strong sulphuric acid, and the solution diluted with water, neutralised with calcium carbonate, and filtered. On adding a neutral solution of ferric chloride to the filtrate, a violet coloration will be obtained.

PIUTTI (*lignin*).—Lignin gives a yellow coloration when treated with *o*-bromophenetidine.

PLANTA (*alkaloids*).—The reagent is practically the same as that of Mayer.

PLUGGE (*phenols*).—This is identical with Millon's reagent.

PLUGGE (*gum ammoniacum*).—On adding a drop of a solution of sodium hypochlorite to a solution containing gum ammoniacum, in the presence of soda lye, a violet coloration is immediately produced.

PLUGGE (*cerium oxide*).—When an alkaline solution of a cerium salt is evaporated, and the residue treated with a few drops of a 1 per cent. solution of strychnine in dilute sulphuric acid, there is produced a bright blue coloration, which disappears, and leaves a permanent cherry-red coloration.

PODWYSSOTZKI (*emetine*).—A recently-prepared solution of ammonium phosphomolybdate in strong sulphuric acid turns brown on contact with emetine. On adding strong hydrochloric acid, a blue coloration is produced.

POLLACCI (*albumin in urine*).—One grm. of tartaric acid and 5 grms. of mercuric chloride are dissolved in 100 c.c. of water, and 100 c.c. of 40 per cent. formalin are added to the solution. Two c.c. of this reagent are added to 4 c.c. of the

urine, so as to form two separate layers, and, in the presence of albumin, a white ring is formed, and diffuses into the liquid.

POLLACCI (*quinine*).—A mixture of 0·01 grm. of the substance, 1 c.c. of water, 2 drops of sulphuric acid, and a trace of lead dioxide is heated to boiling, and then diluted with 3 to 4 c.c. of water. On adding ammonia to the clear liquid, the formation of a green ring indicates the presence of quinine.

POLLACCI (*phenol*).—One drop of aniline is mixed with 30 c.c. of water, 10 drops of this liquid are diluted with 10 c.c. of water, and sodium hypochlorite is added, until a blue coloration is produced. As soon as this coloration has disappeared, ammonia is added, and then the solution to be tested. In the presence of phenol, the blue coloration returns, and is changed to red on the addition of an acid.

POLLACCI (*formaldehyde*).—A solution of codeine in sulphuric acid gives a violet coloration with aqueous solutions of formaldehyde.

POLLACK (*nitric acid*).—The reagent is prepared by dissolving 0·01 grm. of diphenylamine in a mixture of 20 grms. of sulphuric acid (66° Be.) and 60 c.c. of water, and making the solution up to 100 c.c. with sulphuric acid. This reagent gives the well-known blue coloration on contact with nitric acid.

POLLITI (*dextrose*). — The reagent consists of 24·95 grms. of copper sulphate, 140 grms. of potassium sodium tartrate, and 25 grms. of sodium hydroxide in a litre of water. The solution under examination is boiled with an excess of the reagent, and the excess of copper sulphate is titrated with N-sodium thiosulphate solution.

POSSETTO-ISSOGLIO (*saccharin*).—On melting a little saccharin with a fragment of sodium,

dissolving the mass in water, adding hydrochloric acid, and treating the solution with *p*-amino-dimethylaniline, and then with ferric chloride, a blue coloration (formation of methylene-blue) is obtained.

POSSNER (*peptone in urine*).—The urine is made alkaline, and treated with a dilute solution of copper sulphate so as to form two layers. In the presence of peptones, a violet ring is produced at the zone of contact (see PIOTROWSKI; ROSE).

POUTET (*vegetable oils*).—Ten grms. of the oil are treated in a test-tube with 5 grms. of nitric acid (sp. gr. 40° to 42 Be.) and 1 grm. of mercury. After being shaken for three minutes, the tube is put aside for twenty minutes, and is then shaken again for one minute. The mass solidifies more or less rapidly and completely, according to the constitution of the oil and the temperature. Thus, olive oil hardens within fifteen minutes at 14° C., and after sixty-seven minutes at 18° to 19° C.; whilst arachis oil hardens in fifteen minute at 14° C., and in 152 minutes at 18° to 19° C. (*Elaidin reaction*).

PREYER (*hydrocyanic acid*).—A very dilute alcoholic solution of guaiacum resin is treated with a very small amount of copper sulphate solution. On applying a glass rod, which has been moistened with hydrocyanic acid, to a little of this reagent in a porcelain dish, blue streaks are produced, and, on shaking the dish, the whole liquid becomes blue.

PROSCH (*rhubarb in urine*).—The urine is treated with hydrochloric acid, and shaken with xylene, and the xylene extract is separated, and treated with a solution of potassium hydroxide. If the urine contained rhubarb, a rose-coloured ring will be formed at the zone of contact of the liquids. By using chloroform instead of xylene for the extraction a violet ring will be obtained.

PUSCH (*tartaric acid in citric acid*).—One grm. of the citric acid is treated for an hour on the water-bath with 10 grms. of strong sulphuric acid. Pure citric acid gives a yellow coloration, but in the presence of tartaric acid a brown or brownish-red coloration will be produced.

R.

RAABE (*albumin in urine*).—The filtered urine is treated with crystallised trichloracetic acid. In the presence of albumin a turbidity is produced.

RABL (*stain for microscopy*).—This consists of 8 c.c. of a 10 per cent. solution of chromic acid, 200 c.c. of water, and 5 drops of formic acid (sp. gr. 1·2).

RABY (*codeine*).—On treating codeine with sodium hypochlorite and with a few drops of sulphuric acid it gives a blue coloration.

RABUTEAU (*hydrochloric acid in gastric juice*).—A solution of 50 c.c. of starch paste, 1 grm. of potassium iodate, and 0·5 grm. of potassium iodide is coloured blue by free hydrochloric acid in the filtrate from gastric juice.

RAFFAELE (*proteins*).—This is a modification of Spiegler's reagent, in which the acetic acid is replaced by hydrochloric acid.

RASMUSSEN (*hexoses*).—One c.c. of the sugar solution is treated with 16 to 20 drops of a 10 per cent. alcoholic solution of diphenylamine, and then with 1 c.c. of strong hydrochloric acid, and heated until the colour disappears. The liquid is then cooled and extracted with ether, which in the presence of hexoses is coloured blue.

RASPAIL (*proteins*).—Proteins are coloured red when treated with sugar and sulphuric acid (see SCHÜLTZE).

REICH (*cane sugar*).—A solution of cane sugar gives

a violet coloration when treated with a solution of cobalt nitrate, followed by sodium hydroxide.

REICH (*glycerin*).—When a mixture in equal parts of glycerin, phenol, and sulphuric acid is heated to 120° C., the residue cooled, taken up with water, and the solution treated with ammonia, the brown liquid changes to carmine-red.

REICHARD (*santonine*).—When santonine is heated with an alcoholic solution of potassium hydroxide, a carmine-red coloration is produced; but on heating santonine with strong sulphuric acid, a blue coloration is obtained.

REICHARDT (*nitric acid*).—A solution of brucine in strong sulphuric acid gives an intense red coloration with nitric acid. Sensitiveness = 1 : 256,000.

REICHL (*proteins*).—The solution is treated with 2 to 3 drops of an alcoholic solution of benzaldehyde, a certain quantity of sulphuric acid (1 : 1), and a few drops of ferric chloride solution. After some time in the cold, and immediately on heating, an intense blue coloration is produced.

REINSCH (*arsenic*).—A piece of copper foil is immersed in the solution previously acidified with hydrochloric acid. In the presence of arsenic, a grey deposit of copper arsenide is formed upon the copper.

RENARD (*arachis oil*).—The test is based upon the separation of arachidic and lignoceric acids from the fatty acids of the oil. These acids form characteristic crystals with definite melting points.

REUTER (*chloral*).—On heating chloral with phenacetin, a bright violet coloration is obtained.

REYNOLD (*acetone in urine*).—The urine is treated with mercuric chloride and an excess of alcoholic potassium hydroxide solution, and filtered. In the presence of acetone, the filtrate gives a black

precipitate of mercuric sulphide, when treated with hydrogen sulphide.

RICHARDSON (*α- and β-naphthol*).—The solution of the naphthol in sodium hydroxide solution is treated with a small quantity of a reagent consisting of a mixture of 0·05 grm. of sulphanilic acid in 5 c.c. of N-sodium hydroxide solution, and 0·02 grm. of sodium nitrite in 5 c.c. of N-sulphuric acid. Under such conditions, α-naphthol gives a deep blood-red coloration, whilst β-naphthol gives a reddish-yellow coloration.

RIEGLER (*aceto-acetic acid in urine*).—The reagent consists of a solution of iodic acid. This is added to the urine, previously acidified with sulphuric acid, and, in the presence of aceto-acetic acid, produces a red coloration.

RIEGLER (*nitrous acid*).—The reagent consists of an aqueous solution of sodium naphthionate and β-naphthol. On adding a few drops thereof to the liquid to be tested, then hydrochloric acid, and finally ammonia, a red ring is produced when nitrous acid is present.

RIEGLER (*uric acid*).—The reagent is prepared by heating 0·2 grm. of nitro-aniline with 10 c.c. of water and 15 drops of strong sulphuric acid, shaking the solution with 20 c.c. of water, and, when cold, adding 10 c.c. of a 2·5 per cent. solution of sodium nitrite and 60 c.c. of water, and filtering the liquid. The addition of 10 per cent. sodium hydroxide solution and a few drops of this reagent to uric acid, whether in the solid form or in solution, causes a blue or green coloration to appear.

RIEGLER (*albumin in urine*).—Ten c.c. of the urine are treated with 20 drops of a reagent consisting of 8 grms. of asaprol and 8 grms. of citric acid in 200 c.c. of water. In the presence of albumin, a turbidity or precipitate is obtained.

RIEGLER (*formaldehyde in milk*).—The milk is diluted, and shaken with phenylhydrazine hydrochloride and sodium hydroxide solution. In the presence of formaldehyde a pink coloration is produced.

RIEGLER (*sugar*).—A mixture of 0·10 grm. of phenylhydrazine hydrochloride and 0·5 grm. of crystalline sodium acetate is heated with 1 c.c. of the solution under examination until the liquid begins to boil, after which the heating is stopped, and 30 drops of a 30 per cent. solution of sodium hydroxide are added. In the presence of sugar, the liquid becomes violet-red.

RIMINI (*formaldehyde*).—On adding to a solution containing even a minute quantity of formaldehyde a small amount of phenylhydrazine solution, then sodium nitroprusside, and finally potassium hydroxide, a bright blue coloration is produced.

RIMINI (*acetone*). Acetone gives a violet-red coloration when treated with sodium nitroprusside and an aliphatic primary amine.

RINNMANN (*zinc salts*). On heating zinc salts on charcoal with a solution of cobalt nitrate, an infusible green mass is left.

RITSERT (*acetanilide, phenacetin*).—The substance is boiled with hydrochloric acid, and, after cooling, is treated with chlorine water. In the presence of acetanilide, a blue coloration is produced, whilst phenacetin under the same conditions gives a ruby-red coloration.

RITSERT (*sulphonal*).—When heated with pyrogallol, sulphonal emits the unpleasant odour of mercaptan.

ROBINET (*morphine*).—When a neutral solution of a morphine salt is treated with a neutral dilute solution of ferric chloride, it gives a fugitive blue coloration.

ROCHLEDER (*caffeine*).—This is the well-known

murexide test. The substance is gently heated with 2 to 3 drops of nitric acid on the water-bath, and the residue is treated with ammonia solution. In the presence of caffeine, there is produced a purple-red coloration, which, on the addition of an alkali, becomes blue or violet-blue.

ROGERS (*tin salts*).—Salts of tin give a blue coloration with ammonium molybdate solution. Sensitiveness = 1 : 250,000.

ROMAN-DELLUC (*urobilin in urine*).—One hundred c.c. of the urine are shaken in a separating funnel with 10 drops of hydrochloric acid, and, subsequently, with 20 c.c. of chloroform, and allowed to stand. The chloroform layer is separated, and an alcoholic 0·1 per cent. solution of zinc acetate is added, without mixing the liquids. At the zone of contact of the two layers a green ring, characteristic of urobilin, when present, will be produced, and, on shaking the mixture, the green colour will be diffused.

ROSE (*albumin in urine*).—The urine is treated with sodium hydroxide solution, and a 2 per cent. solution of copper sulphate is added, drop by drop, with constant agitation. In the presence of albumin, the liquid becomes red, then violet, and finally deep blue (*biuret reaction*).

ROSENBACH (*biliary pigments in urine*).—The addition of a few drops of a 5 per cent. solution of chromic acid produces a green coloration when biliary pigments are present.

ROSENBACH (*albumin in urine*).—A few drops of 50 per cent. chromic acid are added to the urine without mixing the liquids. In the presence of albumin, an opaque ring is formed at the zone of contact.

ROSIN (*biliary pigments in urine*).—When icteric urine is treated with tincture of iodine, diluted with alcohol, until a madder coloration is ob-

tained, and in such a way that the liquids do not mix, a grass-green ring is produced.

ROUSSIN (*nicotine*). On mixing an ethereal solution of nicotine (1 : 500) with an ethereal solution of iodine (1 : 75), fine crystals of iodonicotine are obtained.

ROUX (*stain for bacteriology*).—Two solutions are prepared:—(A) Dahlia-violet, 1 grm.; 90 per cent. alcohol, 10 c.c.; and water, 10 c.c. (B) Methyl green, 1 grm.; 90 per cent. alcohol, 10 c.c.; and water, 90 c.c. One third of solution A is mixed with two-thirds of solution B, both solutions having been allowed to stand for twenty-five hours, and separately filtered.

RUBNER (*dextrose and lactose*).—Dilute basic lead acetate solution and ammonia are added drop by drop to the liquid under examination, until a permanent precipitate is obtained. In the presence of dextrose or lactose, this becomes yellow, and then flesh-coloured, the changes being more rapid on applying heat.

RUBNER (*carbon monoxide in blood*).—One part of the blood is shaken for one minute with 4 to 5 parts (by volume) of lead acetate solution. Normal blood becomes blackish brown, whilst blood containing carbon monoxide retains its bright red colour.

RUGGERI (*dulcine*). When a small quantity of dulcine is treated with a few c.c. of a 6 per cent. solution of silver nitrate, or a 5 per cent. solution of mercuric chloride, and evaporated to dryness on the water-bath, the residue, after being heated for some time, assumes a fine violet colour, which becomes more pronounced if the heating is continued on a sand bath at 160° C. On treating the residue, while still hot, with alcohol, a wine-red solution is obtained.

RUNGE (*aniline*).—Aniline treated with calcium hypochlorite solution gives a purple-violet

coloration, which changes to pink on the addition of acids.

RUSTING (*salts of cobalts*).—See VOGEL.

S.

SABANIN-LASKOWSKY (*citric acid*).—When citric acid (0·01 grm.) is heated with six times its weight of ammonia solution in a sealed tube for some hours at 118° to 120° C., and is then transferred to a porcelain basin, it should, after some hours, become blue and then green (differentiation from oxalic, malic, and tartaric acids).

SADLUND (*iodine in urine*). –Five c.c. of the urine are treated with 1 c.c. of dilute sulphuric acid, and 2 to 3 drops of sodium nitrite solution (0·2 in 100). On then shaking the urine with carbon bisulphide, iodine, if present, is extracted, giving the usual violet solution.

SAHLI (*reagent for microscopy*).—This consists of a solution of 0·75 grm. of methylene-blue and 0·8 grm. of borax in 80 c.c. of water.

SAILLET (*urobilinogen in urine*).—This reaction will detect urobilinogen in the presence of urobilin. One hundred c.c. of the urine, which has been recently emitted and kept in the dark, are acidified with 10 drops of acetic acid, and shaken with an equal volume of ethyl acetate. The extract is shaken with a small quantity of water, which extracts the urobilin, forming a brown solution, whilst the urobilinogen remains in the ethylacetate, and, on exposure to the light, changes into urobilin.

SALKOWSKI (*cholesterol*).—On shaking a solution of a few centigrms. of cholesterol in chloroform with an equal volume of strong sulphuric acid, the chloroform becomes blood-red, whilst the

acid shows a green fluorescence. When a little of the chloroform solution is treated with water, it gives a blue coloration, which changes to green, and finally to yellow.

SALKOWSKI (*phenol*).—When a solution of phenol is treated with about a fourth of its volume of ammonia solution, and then with a few drops of calcium hypochlorite solution, and the mixture slightly heated, a blue coloration is obtained.

SALKOWSKI (*indol*).—On adding to a solution of indol a little nitric acid, and then, drop by drop, a 2 per cent. solution of potassium nitrite, a red coloration, and subsequently a red precipitate is obtained.

SALKOWSKI (*carbon monoxide in blood*).—(1) The blood is diluted with twenty times its volume of water, and a small quantity of the liquid is treated with an equal volume of sodium hydroxide solution (sp. gr. 1·38). Blood containing carbon monoxide first becomes turbid and then turns bright red, whilst flocculent particles of the same colour separate and float upon the surface of the liquid. Normal blood, under the same conditions, becomes dirty brown in colour.

(2) A mixture of 0·9 c.c. of the blood, 50 c.c. of water, and 25 c.c. of an aqueous solution of hydrogen sulphide becomes dirty green within a few minutes if carbon monoxide is not present. Blood containing the gas does not alter in colour on the addition of hydrogen sulphide.

SALKOWSKI (*pentosans in urine*).—(1) The urine under examination is mixed with an equal volume of strong hydrochloric acid, and heated with a small quantity of orcinol. In the presence of pentosans, the mixture assumes a fugitive red or violet colour, and then becomes green. Amyl alcohol extracts from this liquid a substance which is first red and then green.

(2) Phloroglucinol is dissolved in 6 c.c. of

strong hydrochloric acid, leaving a slight excess undissolved. The solution is divided into two parts, and to one of these is added 0·5 c.c. of the urine under examination, whilst the other receives an equal quantity of normal urine. Both test-tubes are immersed in boiling water, and examined after a short time. In the case of urine containing pentosans, a red zone will be formed, and the colour well diffused into the rest of the liquid, whilst normal urine will show no alteration in colour.

Salkowski (*peptones in urine*).—Fifty c.c. of the urine are acidified with 50 c.c. of hydrochloric acid, and heated with phosphotungstic acid. The liquid is filtered, and the precipitate is dissolved in 8 c.c. of water mixed with 0·5 c.c. of sodium hydroxide solution (sp. gr. 1·16). The bright blue liquid thus obtained becomes turbid on heating, and changes its colour to yellow. It is cooled, and treated, drop by drop, with a dilute solution of copper sulphate. In the presence of peptone, the liquid turns red.

Sangle-Ferriere (*abrastol in wine*).—200 c.c. of the wine are acidified with 8 c.c. of hydrochloric acid, and boiled for an hour beneath a reflux condenser. The liquid is then cooled, and extracted with petroleum spirit, and the extract is allowed to evaporate spontaneously. The residue is taken up with 10 c.c. of chloroform, and the solution is treated with a fragment of potassium hydroxide and a few drops of alcohol, and boiled for two minutes. In the presence of abrastol, a deep blue coloration is produced, which rapidly changes to green, and then to yellow.

Sanna-Pintus (*abrastol in wine*).—Ten c.c. of the wine are decolorised, in the cold, with 2 grms. of animal charcoal, and the decolorised liquid is treated with an equal volume of a solution of mercuric nitrate containing nitric acid (100 grms.

of mercury dissolved in 07 c.c. of nitric acid of 42 Be. and diluted with 35 c.c. of water). A yellow coloration, appearing golden by reflected light, indicates the presence of abrastol.

SCHAER (*morphine*).—A neutral solution of morphine gives a blue coloration, when treated with a very dilute solution of ferric chloride.

SCHAER (*blood*). A 75 per cent. solution of chloral hydrate containing the blood is mixed with a dilute solution of aloine and chloral hydrate, and hydrogen peroxide is added to the mixture. A violet-red zone, which is formed after a short time, indicates the presence of blood.

SCHÄFFER (*cocaine*). When 0·02 grm. of cocaine hydrochloride is dissolved in 1 c.c. of sulphuric acid and a drop of water, a colourless solution is obtained; but, on adding a drop of potassium bichromate solution, a precipitate, which rapidly disappears, is formed, whilst the reddish-yellow colour of the solution changes to green, on heating.

SCHÄFFER (*unboiled and boiled milk*).—Ten c.c. of the milk are shaken with 1 drop of 0·2 per cent. hydrogen peroxide solution, and 2 drops of a 2 per cent. solution of *p*-phenylenediamine. Unboiled milk gives a blue coloration.

SCHÄFFER (*nitrites in urine*).—Four c.c. of the urine are decolorised with animal charcoal, and treated with 4 c.c. of 10 per cent. acetic acid and with 3 drops, at most, of 5 per cent. potassium ferrocyanide solution. In the presence of nitrites, an intense yellow coloration is produced. Sensitiveness = 0·000045 grm. of N_2O_3 in 100 c.c.

SCHÄRGE (*cocaine*).—See SCHÄFFER.

SCHEIBLER (*alkaloids*). The reagent consists of phosphotungstic acid. Ordinary sodium tungstate is dissolved in boiling water containing about half its weight of phosphoric acid (sp. gr. 1·13). On evaporating the liquid,

crystals of phosphotungstic acid are left, and a 10 per cent. solution of these constitutes the reagent. It gives white precipitates with solution of alkaloids. It also precipitates albumoses and peptones.

SCHERER (*phosphorus*). — The substance under examination (*e.g.*, contents of the stomach), which ought to have an acid reaction, is placed in a stoppered flask, and within the neck of the flask are suspended two strips of filter-paper, one impregnated with silver nitrate solution, and the other with lead nitrate solution. In the presence of phosphorus, only the silver paper is darkened.

SCHERER (*inosite*).—The aqueous solution of the substance is evaporated with nitric acid nearly to dryness, and the residue is treated with ammonia and with a trace of calcium chloride, and again evaporated. In the presence of inosite, a red coloration is obtained.

SCHERER (*tyrosine*).—On evaporating a small quantity of tyrosine with nitric acid, a residue which gives a brownish-red coloration with ammonia or sodium hydroxide, is obtained.

SCHIFF (*uric acid*).—A solution of uric acid, rendered alkaline, reduces silver nitrate, giving a black deposit.

SCHIFF (*aldehydes*). — An aqueous solution of magenta (0·025 per cent.) decolorised with sulphur dioxide has its pink colour restored by aldehydes (see GAYON).

SCHIFF (*cholesterol*).—On heating crystals of cholesterol with a mixture of 2 parts of hydrochloric acid and 1 part of ferric chloride solution, a red coloration is obtained, whilst the liquid, when evaporated, leaves a violet residue. Or, on evaporating cholesterol with nitric acid to dryness, the resulting residue gives a red coloration when treated with a drop of ammonia solution.

SCHIFF (*dextrose and carbohydrates in general*).—Test papers are prepared by immersing strips of filter-paper in a solution composed of equal parts of glacial acetic acid and of xylidine in a little alcohol. These become red when exposed to the vapours produced by heating carbohydrates.

SCHIFF *urea*).—When a crystal of urea is treated with 1 drop of furfural water (water shaken with furfural) and with 1 drop of hydrochloric acid, the mixture becomes successively yellow, green, blue, violet, and purple-violet.

SCHINDELMEISTER (*nicotine*).—When a trace of the alkaloid is treated with a drop of 30 per cent. formaldehyde free from formic acid, and the mixture left for several hours and then treated with a drop of nitric acid, a scarlet or deep red coloration is produced.

SCHLAGDENHAUFFEN (*alkaloids*).—The reagent consists of a solution of selenious acid in strong sulphuric acid.

SCHLAGDENHAUFFEN (*differentiation of alkaloids from glucosides*).—A mixture in equal parts of tincture of guaiacum and a saturated solution of mercuric chloride gives a blue coloration with alkaloids, but not with glucosides.

SCHLESINGER (*biliary pigments in urine*).—Equal parts of the urine and of a 10 per cent. solution of zinc acetate in absolute alcohol are shaken, and filtered. In the presence of urobilin a green fluorescence is obtained, which appears more distinct when observed across the cone of light from a lens. The presence of blood in the urine interferes with the test, but albumin does not affect the result. It is essential that the reagent should be freshly prepared, and thoroughly shaken.

SCHLESINGER-HOLT (*blood in urine*).—Ten c.c. of the urine are shaken with about 1 c.c. of acetic acid, and the mixture then treated with about a

third of its volume of ether, and again shaken. The ethereal layer is separated, and shaken with 10 drops of absolute alcohol, then allowed to stand, separated from the alcohol, and added to a benzidine reagent freshly prepared as follows :— A little of the benzidine is dissolved in 2 c.c. of acetic acid, and 0·5 c.c. of this solution is diluted with 2 to 3 c.c. of 3 per cent. hydrogen peroxide solution. On shaking the ethereal extract with this reagent, a green coloration is obtained if the urine contained a small quantity of blood, or a blue coloration if a large amount was present.

SCHLICKUM (*arsenic*).—A solution of 0·4 grm. of stannous chloride in 4 grms. of hydrochloric acid is mixed with 0·01 grm. of sodium sulphide, and the solution under examination is added to the mixture. In the presence of arsenic, a yellow ring of arsenic sulphide is formed at the zone of contact, and the test is capable of detecting $\frac{1}{20}$ mgrm. of arsenic.

SCHLOSSBERGER (*textile fibres*).—The reagent consists of a solution of freshly-prepared nickelous hydroxide in strong ammonia solution. It dissolves silk, but not cotton or wool.

SCHMIDT (*oxydases*).—A 5 per cent. alcoholic solution of guaiacum gives a blue coloration in the presence of oxydases.

SCHMIDT (*saccharin*).—See PINETTE.

SCHMIDT (*urobilin and hydrobilirubin*).—A saturated aqueous solution of mercuric chloride gives a red coloration with hydrobilirubin and with urobilin, whilst with bilirubin it gives a green coloration.

SCHMIDT (*dextrose*).—On heating an ammoniacal solution of lead acetate with urine containing dextrose, a brownish-red precipitate is obtained.

SCHMIDT (*apomorphine*).—When 10 c.c. of a solution of apomorphine hydrochloride are shaken with 1 c.c. of chloroform, and with a few drops of

potassium hydroxide solution, the aqueous layer becomes violet, and the chloroform blue.

SCHNEIDER (*alkaloids*). When strong sulphuric acid is added to an intimate mixture of an alkaloid with cane sugar, various colorations are produced. For example, morphine and codeine give a purple-red coloration, which changes to greenish-violet, and then to yellow.

SCHNEIDER (*bismuth salts*).—When a salt of bismuth is heated with a reagent consisting of a mixture of 3 parts of tartaric acid, 1 part of stannous chloride and sufficient potassium hydroxide solution to give a clear liquid, a black precipitate is obtained.

SCHNEIDER (*colza oil in olive oil*). One part of the oil is dissolved in 2 parts of ether, and the solution shaken with 20 drops of a saturated alkaline solution of silver nitrate, and left for twelve hours in the dark. The liquid darkens, or becomes black, in the presence of colza oil.

SCHÖNBEIN (*ozone*).—A solution of starch and potassium iodide becomes blue on contact with ozone.

SCHÖNBEIN (*hydrogen peroxide*). A neutral, or slightly acid solution of hydrogen peroxide, gives a blue coloration, on treatment with ferrous sulphate and a solution of zinc iodide and starch.

SCHÖNBEIN-PAGENSTECKER (*hydrocyanic acid*). Strips of filter-paper are dipped in guaiacum tincture, and then dried, and dipped in 0·1 per cent. copper sulphate solution. They turn blue on contact with hydrocyanic acid. The reaction is also given by ozone and other oxidising agents.

SCHRYVER (*formaldehyde*). Ten c.c. of the liquid under examination are treated with 2 c.c. of a recently-prepared and filtered 1 per cent. solution of phenylhydrazine hydrochloride, 1 c.c. of a

freshly-prepared 5 per cent. solution of potassium ferricyanide, and 5 c.c. of strong hydrochloric acid. In the presence of formaldehyde, a red coloration is obtained. Sensitiveness — 1 : 1,000,000.

SCHUCHARDT (*free hydrochloric acid in gastric juice*). —See VON DER VELDEN.

SCHULTZ (*salicylic acid*).—An aqueous solution of salicylic acid, when treated with a small quantity of copper sulphate solution, gives a green coloration, which disappears on the addition of ammonia or mineral acids.

SCHULTZE (*alkaloids*).—The reagent is a solution of phospo-antimonic acid, prepared by mixing 4 parts of a saturated solution of sodium phosphate with 1 part of antimony chloride. It gives white precipitates with most alkaloids.

SCHULTZE (*cellulose*).—A solution of 250 grms. of zinc chloride and 80 grms. of potassium iodide in 85 c.c. of water, saturated with iodine, gives a blue coloration with cellulose.

SCHULTZE (*solution for microscopy*). — (1) An aqueous 1 per cent. solution of osmic acid. (2) A solution of 0·1 to 0·3 grm. of palladium chloride in 100 c.c. of water.

SCHULTZE (*proteins*).—A solution of the substance in sulphuric acid is mixed with a trace of sugar, and heated to 60° C. In the presence of proteins a bluish-red coloration is produced.

SCHULZ (*carbon monoxide in blood*).—See WETZEL.

SCHUMPELITZ (*veratrine*).—On mixing a solution of fused zinc chloride in dilute hydrochloric acid with a few drops of a salt of veratrine, and allowing the liquid to evaporate, a red coloration is produced.

SCHUYTEN (*nitrous acid*).—The reagent is prepared by diluting 10 c.c. of a solution of 1 part of antipyrin in 10 parts of acetic acid with 10 c.c. of water. On treating 5 c.c. of the liquid

under examination with 5 c.c. of the reagent, the formation of a green coloration indicates the presence of nitrous acid (see CURTMANN).

SCHWARZ (*sulphonal*).—Sulphonal, when heated on charcoal, emits an odour of mercaptan.

SCHWARZ (*chloroform*).—When chloroform is heated with resorcinol and alcoholic potassium hydroxide solution, the liquid becomes reddish-yellow, and sometimes shows a green fluorescence.

SCHWEITZER (*textile fibres*).—The reagent is a concentrated solution of freshly-precipitated and still moist copper hydroxide in 20 per cent. ammonia solution. It dissolves cotton, linen and silk, but not wool.

SEIDEL (*inosite*).—The liquid under examination is evaporated with nitric acid, and the residue is treated with a solution of strontium acetate. The presence of inosite is indicated by the appearance of a violet coloration.

SELIWANOFF (*lævulose*).—When lævulose is heated with resorcinol and hydrochloric acid it gives a red coloration, and then a red precipitate soluble in alcohol.

SELMI (*coniine and nicotine*).—An aqueous solution of these alkaloids gives a black precipitate with potassium sulphoplatinite. In the presence of 50 per cent. acetic acid the reaction is given only by nicotine, and not by coniine.

SELMI (*blood*).—The reaction is based on the separation of crystals of hæmin by means of sodium tungstate and acetic acid.

SENIER-LOWE (*glycerin*).—When a borax bead is moistened with a liquid containing glycerin, and heated in a gas flame, it becomes green.

SILVA (FERREIRA DA) (*cocaine*).—On evaporating cocaine to dryness with fuming nitric acid, and adding to the residue 2 drops of a saturated alcoholic solution of potassium hydroxide, an odour of peppermint is developed.

Silva (Ferreira da) (*eserine*).—On dissolving a small quantity of eserine or one of its salts in fuming nitric acid, there is obtained a clear yellow solution, which becomes orange-red when heated, and, evaporated on the water-bath, leaves a green residue. This residue is soluble in water and in alcohol, and, when treated with nitric acid, gives a solution with a greenish-yellow and blood-red fluorescence.

Simon (*acetaldehyde*).—A very dilute solution of acetaldehyde (as weak as 0·0001 per cent.), when treated with an aqueous solution of trimethylamine and with a very dilute solution of sodium nitroprusside until coloured, gives a blue coloration. The same reaction is given by phenylhydrazine when heat is applied. On adding potassium hydroxide, the colour is intensified, whilst, on the addition of acetic acid, it is changed to bright blue.

Skey (*salts of cobalt*).—When a solution of a cobalt salt is treated with tartaric or citric acid, and then with an excess of ammonia and with potassium ferricyanide, it gives a deep red coloration.

Smith (*biliary pigments in urine*).—One drop of tincture of iodine is added to the urine. In the presence of biliary pigments, a green coloration is produced. Ferric chloride, lead peroxide, and hydrogen peroxide act in the same way as iodine.

Soldaini (*dextrose*).—The reagent consists of a solution of 15 grms of copper carbonate, and 416 grms. of potassium bicarbonate in 1,000 c.c. of water. When boiled with dextrose or lactose, it yields a red deposit of cuprous oxide.

Soltsien (*sesamé oil*).—Six grms. of the oil are heated with 2 c.c. of Bettendorf's reagent on the water-bath for some minutes, with constant

agitation. The stannous chloride solution becomes of an intense wine-red colour when sesamé oil is present. Sensitiveness = 1 : 100.

Sonnenschein (*alkaloids*.—(1 Phosphomolybdic acid gives yellow precipitates with slightly acid solutions of alkaloids. The reagent is prepared by treating a nitric acid solution of ammonium molybdate with phosphoric acid, washing the precipitate, boiling it with *aqua regia* until the ammonium salt is completely decomposed, and evaporating the solution to dryness. The residue is then dissolved in 10 per cent. nitric acid.

(2) Another reagent for alkaloids is prepared by passing a current of chlorine into a solution of an alkali, in which is suspended cerous hydroxide, until brown cerium oxide is obtained. This is collected on a filter, and dried. The reagent is used by dissolving the alkaloid in strong sulphuric acid, and treating the solution with a trace of cerium oxide. Under these conditions atropine gives a brownish-yellow coloration, quinine a yellow; codeine, olive-green; emetine, brown; narcotine, first brown and then cherry-red; strychnine, blue, then violet, and finally cherry-red; and veratrine, a brownish-red coloration.

Sonnenschein (*blood*).—A dilute filtered solution of blood gives, with phosphotungstic acid, a voluminous brownish-red precipitate, which is soluble in ammonia, forming an intense red solution. This solution shows the spectrum of reduced methæmoglobin.

Spiegler (*albumin in urine*).—The reagent consists of 8 grms. of mercuric chloride, 4 grms. of tartaric acid, and 20 grms. of sugar in 200 c.c. of water. When added to albuminous urine, a white ring is fomred at the zone of contact of the two liquids. Sensitiveness = 1 : 225,000.

SPRENGEL (*nitric acid*).—The substance under examination is treated with 2 drops of a solution of 1 part of phenol in 4 parts of strong sulphuric acid and 2 parts of water. In the presence of nitric acid, there is produced a pink-brown coloration, which changes to yellow on the addition of ammonia.

STAHRE (*citric acid*).—When a solution of free citric acid, or of a citrate, in very dilute sulphuric acid is gradually heated with 2 to 5 drops of N-10 potassium permanganate solution to 30°—40° C., a brown coloration is obtained. On now adding 1 to 2 drops of ammonium oxalate solution, and about 1 c.c. of 10 per cent. sulphuric acid, the liquid becomes clear again, and, on then treating it with a few drops of bromine, a crystalline precipitate of tetrabromo-acetone will be formed. Sensitiveness = 0·3 mgrm. in 1 c.c. of water.

STENHOUSE (*caffeine*).—When caffeine is heated for a few minutes with nitric acid, the solution evaporated, and the residue moistened with ammonia, a purple-red coloration, which becomes fainter on the addition of potassium hydroxide solution, is obtained.

STOCKWIS (*biliary pigments in urine*).—Thirty c.c. of the urine are treated with 10 c.c. of a 20 per cent. solution of zinc chloride, the zinc precipitated with sodium carbonate, and the washed precipitate dissolved in ammonia solution. In the presence of biliary pigments, the solution will be of a green colour and fluorescent.

STORCH (*unboiled and boiled milk*).—See SCHÄFFER.

STORCH-MORAWSKI (*resin oils and resins in oils*).—A small quantity of the oil under examination is dissolved in warm acetic anhydride, and the solution, when cold, is treated with a few drops of sulphuric acid. In the presence of resin oils, or resins, violet-blue or red colorations are

produced, and, finally, the solution becomes fluorescent brownish-yellow.

STROPPA (*solanine*).—On treating a little solanine in a porcelain basin with 2 drops of a dilute solution of potassium iodide and 2 c.c. of dilute sulphuric acid (1 : 7), and heating the mixture, with agitation, to 75° to 80° C. on the water-bath, it becomes successively yellow, red, violet, blue, and finally green.

STRUVE (*blood in urine*).—The urine is treated with ammonia, and then with tannin and acetic acid, until the reaction becomes acid. In the presence of blood, a red precipitate is formed, and this when dried and treated with acetic acid and sodium chloride yields characteristic hæmin crystals.

STRZYOWSCKY (*albumin in urine*).—Ten c.c. of the urine are treated with a little 10 per cent. ammonium persulphate solution. In the presence of albumin, a greyish-white ring is formed at the zone of contact of the liquids.

SWOBODA (*picric acid*).—On treating a cold aqueous solution of picric acid with an aqueous solution of methylene-blue there is formed a violet precipitate, which dissolves in chloroform, to form a blue solution, and this, when evaporated, leaves a violet residue.

SZANKAY (*cocaine*).—When cocaine is triturated with iodol it emits a pleasant odour, recalling that of hyacinth.

T.

TAFEL (*strychnine*).—When a solution of 0·1 grm. of strychnine sulphate in 10 c.c. of water is treated with 2 drops of water, 4 drops of hydrochloric acid, and an excess of zinc powder, reduction of the strychnine takes place, with the formation of tetrahydrostrychnine and

strychnidine. If the liquid is then heated and filtered, and the filtrate treated with a drop of ferric chloride solution, a blood-red coloration, which does not disappear on heating, is obtained.

TAMBON (*sesamé oil in olive oil*).—Five c.c. of colourless nitric acid (1 : 10) are shaken for two minutes with 15 c.c. of the oil, and the mixture allowed to stand. In the presence of sesamé oil, the acid layer becomes yellow, and, when separated by decantation and treated with a sufficient quantity of water, becomes more or less turbid. In the case of pure sesamé oil a white flocculent precipitate is obtained.

TANRET (*albumin in urine*).—The reagent consists of 3·32 grms. of potassium iodide and 1·35 grms. of mercuric chloride in 20 c.c. of acetic acid and 60 c.c. of water. When added in sufficient quantity to albuminous urine, it gives a white precipitate. Alkaloids also give a precipitate, which, however, is soluble in ether. The albumin precipitate is insoluble in hot acetic acid, whereas the precipitate given by any peptones present is soluble therein.

TATTERSALL (*salts of cobalt*).—On treating a solution of a cobalt salt with potassium cyanide solution until the precipitate first formed is redissolved, and then adding ammonium sulphide, a blood-red coloration is produced. This reaction takes place in the presence of nickel salts, but copper salts interfere with it.

TATTERSALL (*morphine*). — When morphine is treated with strong sulphuric acid and sodium arsenate, the mixture becomes dirty violet and then sea-green.

TATTERSALL (*papaverine and codeine*).—The substance is heated with a little strong sulphuric acid, sodium arsenate then added, and the heating continued over a low flame, with stirring. In the presence of papaverine, there is produced a bright

red to violet coloration, which changes to yellow on the addition of 10 c.c. of water, and to black when sodium hydroxide is subsequently added. Codeine, under the same conditions, gives a deep blue coloration, which changes to orange when treated with water and sodium hydroxide.

TEICHMANN (*blood*).—The substance under examination is treated with glacial acetic acid and a trace of sodium chloride, and gently heated several times until bubbles appear. In the presence of blood, the characteristic crystals of hæmin separate.

THEATER (*santonine*).—When santonine is treated with 2 to 3 drops of a 2 per cent. alcoholic solution of furfural, and then with 2 c.c. of strong sulphuric acid, and the mixture is heated on the water-bath until the alcohol evaporates, a purple-red coloration, changing to carmine-red and then to blue, is produced. Sensitiveness = 0·1 mgrm.

THENARD (*aluminium salts*).—Aluminium salts, when heated for some time on charcoal, and then moistened with cobalt nitrate, yield a fused mass of blue colour.

THERENON (*formaldehyde*).—Metol gives a garnet-red coloration with formaldehyde. The reaction is promoted by a gentle heat, not exceeding 75° C.

THOMS (*dulcine*).—On treating a small quantity of dulcine with 2 to 3 drops of pure phenol, and with the same quantity of strong sulphuric acid, and then heating the mixture to boiling point, a red syrup is obtained. When this is introduced into a test-tube half full of water, and the liquid completely cooled and treated with sodium hydroxide or ammonia, two layers are formed, on the edges of which a blue ring immediately appears.

THOMSON (*veratrine*).—Strong sulphuric acid gives

a blood-red coloration with veratrine after about four minutes.

THORMAHLEN (*melanine in urine*).—The urine is treated with sodium nitroprusside, potassium hydroxide, and acetic acid, and, in the presence of melanine, gives a deep blue coloration.

TOCHER (*sesamé oil in olive oil*).—(1) Ten c.c. of formaldehyde (40 per cent.) are mixed with 50 c.c. of water, and 100 c.c. of sulphuric acid. On mixing 5 c.c. of this reagent with 5 c.c. of the oil, the resulting emulsion becomes a permanent blackish-blue if sesamé oil is present.

(2) Fifteen c.c. of the oil are shaken with a solution of 1 grm. of pyrogallol in 14 c.c. of hydrochloric acid, and the acid layer is separated, and heated for a few minutes. In the presence of sesamé oil, a violet coloration is obtained.

(3) When 2 c.c. of sesamé oil are shaken with 2 c.c. of a saturated solution of resorcinol in petroleum spirit, and 2 c.c. of strong nitric acid, a violet-blue coloration is obtained.

(4) On shaking sesamé oil with a reagent consisting of 4 grms. of ammonium vanadate in 50 c.c. of water and 100 c.c. of strong sulphuric acid, a green coloration is produced.

TODTENHAUPT (*formaldehyde*).—When a dilute solution of ammonium sulphide is treated with a little formaldehyde, a turbidity is obtained, and, on the further addition of the aldehyde, a fine crystalline precipitate gradually forms.

TOLLENS (*dextrose*).—A solution of silver nitrate is treated with potassium hydroxide, and then with sufficient ammonia to redissolve the precipitate first formed. This reagent is reduced by dextrose, and gives a black coloration.

TOLLENS (*pentoses*).—Pentoses give a cherry-red coloration when heated with strong hydrochloric acid and phloroglucinol.

TOMMASI (*phenol*).—See HOPPE-SEYLER.

TÖPFER (*hydrochloric acid in gastric juice*).—The reagent consists of a solution of dimethylamino-azobenzene, which gives a red coloration with free or combined hydrochloric acid.

TORTELLI-PIAZZA (*saccharin*).—When saccharin is heated with magnesium powder, it yields magnesium sulphide, which gives a violet coloration with sodium nitroprusside.

TORTELLI-RUGGERI (*cotton oil*).—The liquid fatty acids of the oil are separated, and from 5 to 6 grms. thereof are dissolved in 10 c.c. of pure 99 per cent. alcohol. The solution is treated with 1 c.c. of a 5 per cent. aqueous solution of silver nitrate, and the mixture is heated on the water-bath at 70° to 80° C. In the case of pure cotton oil, there is produced immediately a reddish coloration, which soon changes to brownish-red, whilst the liquid becomes turbid, and appears violet-blue by transmitted light. Oils free from cotton oil do not show any coloration after thirty minutes, whilst mixtures containing 1 per cent. or more of cotton oil soon show a deep brown coloration.

TORTI (*resorcinol*).—On heating a crystal of resorcinol with a few drops of nitric acid (sp. gr. 1·40) an intense red coloration is produced. Sensitiveness = 0·25 mgrm.

TRAPP (*veratrine*).—A permanent purple-red coloration is obtained on heating veratrine with strong hydrochloric acid.

TRILLAT (*formaldehyde*).—The liquid under examination is heated with dimethylaminiline and sulphuric acid, and then made alkaline, and freed from the excess of dimethylaniline by means of a current of steam, followed by filtration. On moistening the filter with acetic acid, and adding lead dioxide, a violet coloration is produced.

TROMMER (*dextrose in urine*).—The urine, when heated with copper sulphate and sodium hydroxide, gives a precipitate, which redissolves on heating, forming a blue solution, which changes to red on the precipitation of cupric hydroxide.

TROMMSDORF (*nitrous acid*).—Five grms. of zinc chloride are dissolved in 100 c.c. of water, and the solution is mixed with 5 grms. of starch, and boiled until the starch has dissolved, the water which evaporates being renewed from time to time. Two grms. of zinc iodide are then added, and the solution is made up to a litre, and filtered. On adding this reagent to a liquid containing nitrous acid, an intense blue coloration is obtained.

TRUCHOT (*artificial silk*).—A little of the material is dissolved in sulphuric acid (66° Be.), and a crystal of diphenylamine dissolved in strong sulphuric acid is added to the syruppy solution. Under these conditions, natural silk remains colourless, whilst artificial silk (nitrocellulose) produces a blue coloration.

TSCHUGAEFF (*salts of nickel*).—The solution under examination is treated with ammonia until the reaction is slightly alkaline, and then with 1 to 2 c.c. of a 1 per cent. alcoholic solution of dimethylglyoxime. In the presence of nickel, a red precipitate separates on boiling the liquid. Sensitiveness = 1 : 400,000.

U.

UDRANSKY (*biliary acids in urine*).—Five c.c. of the urine are treated with 5 drops of a 0·1 per cent. aqueous solution of furfural, and then with 5 c.c. of sulphuric acid, while kept cold. In the presence of biliary acids, a red coloration is produced.

UDRANSKY (*cholesterol*).—When a mixture of 10 c.c. of an alcoholic solution of cholesterol, and of 5 drops of a 0·5 per cent. aqueous solution of furfural, is treated with 5 c.c. of strong sulphuric acid in such a way that the liquids do not mix, and is then cooled, and gently shaken, there is produced an intense red coloration, which changes to blue.

UDRANSKY (*phenol and paracresol*).—On treating 5 c.c. of an aqueous solution of phenol with 5 drops of a 0·5 per cent. aqueous solution of phenol and 5 c.c. of strong sulphuric acid, the mixture becomes bluish-red or blue. A solution of paracresol, under the same conditions, gives a bright red coloration, changing to violet and then to blue.

UDRANSKY (*dextrose in urine*).—From 2 to 3 c.c. of the urine are treated with 5 drops of a 15 per cent. solution of α-naphthol, and then with 5 c.c. of strong sulphuric acid. In the presence of dextrose, a violet ring is formed at the zone of contact, whilst the liquid, when shaken, becomes carmine-red.

UDRANSKY (*scatol*).—On treating a solution of scatol with a drop of a 2 per cent. aqueous solution of furfural, and with strong sulphuric acid, a brownish-red coloration is obtained.

UDRANSKY (*tyrosine*). When an aqueous solution of tyrosine is treated with a few drops of aqueous furfural, and with an equal volume of strong sulphuric acid, and then cooled, a pale red mixture is obtained.

UFFELMANN (*lactic acid in gastric juice*).—The reagent consists of a mixture of 1 drop of ferric chloride solution with a solution of 0·4 grm. of phenol in 100 c.c. of water. In the presence of lactic acid, it gives a yellow coloration.

UFFELMANN (*coriander in flour*). On heating the flour with a dilute alcoholic solution of sodium

hydroxide, a yellow coloration, changing to red, is obtained.

Ultzmann (*biliary pigments in urine*).—See Gmelin.

Utz (*blood*).—An alkaline solution of phenolphthalein, decolorised by reduction with zinc powder, becomes pink again on contact with hydrogen peroxide and blood.

V.

Valser (*alkaloids*).—The reagent consists of a 10 per cent. aqueous solution of potassium iodide saturated with mercuric iodide.

Vanino-Seemann (*hydrogen peroxide*).—Hydrogen peroxide in alkaline solution immediately precipitates gold, in a fine state of division, from solutions of gold salts. The precipitate appears blackish-brown by reflected light, and blue-green by transmitted light. Sensitiveness = 0·03 mgrm. of gold in 10 c.c. of liquid.

Velden (van der) (*hydrochloric acid in gastric juice*).—A yellow aqueous or alcoholic solution of tropæolin OO gives a bright red, or brown-red coloration with hydrochloric acid.

Villavecchia-Fabris (*sesamé oil in olive oil*).—From 5 to 10 c.c. of the oil are added to 2 to 3 drops of a 2 per cent. alcoholic solution of furfural, and the mixture is shaken for a few seconds with 10 c.c. of strong hydrochloric acid, and allowed to stand. In the presence of as little as 1 per cent. of sesamé oil, the lower acid layer will be of a red colour, which becomes more pronounced on standing, whilst the upper oily layer will appear as a yellowish emulsion mixed with red.

Vitali (*biliary acids in urine*).—A small quantity of the liquid under examination is treated with

strong sulphuric acid until it dissolves, and a few drops of chlorine water are added in such a way that the liquids do not mix. After a few seconds, if biliary acids are present, green streaks will appear at the zone of contact, the colour then changing to blue, violet, and red. On adding a large amount of sulphuric acid to the liquid, a green fluorescence will be observed.

VITALI (*alkaloids*).—When alkaloids are evaporated with fuming nitric acid on the water-bath, and the residue is treated with 1 drop of an alcoholic solution of potassium hydroxide, various colorations are produced. Atropine, for example, gives a violet coloration.

VITALI (*aniline*).—On treating aniline with strong sulphuric acid, in which is dissolved a crystal of potassium chlorate, a violet coloration, which is intensified by the addition of a little water, is obtained.

VITALI (*chloroform*).—When chloroform is heated with a fragment of sodium hydroxide and a little thymol, a fine violet coloration is produced.

VITALI (*iodoform*).—A red coloration is obtained by mixing iodoform with phenol and potassium hydroxide solution, and heating the mixture to boiling point.

VITALI (*hydrastine*).—On treating hydrastine with a few drops of nitric acid, a yellow coloration is produced, and on now heating the mixture to boiling point, and then evaporating the acid at a gentle heat, a yellow residue is left. This becomes brown on the addition of alcoholic potassium hydroxide solution, and the liquid, when evaporated to dryness, leaves a brown residue, which becomes intense violet on the addition of strong sulphuric acid.

VITALI (*sulphonal*).—When sulphonal is heated with three times its volume of potassium hydroxide solution it emits a garlic odour, and

the solution on cooling becomes scarlet, changing to blue on the addition of water. On then adding hydrochloric acid, an odour of sulphur dioxide is evolved, and the colour becomes violet.

VITALI (*acetone*).—When acetone is shaken with a drop of potassium hydroxide solution and a little carbon bisulphide, and a crystal of ammonium molybdate and an excess of sulphuric acid then added, a wine-red coloration is produced.

VITALI-MAHLER (*saccharin*).—When saccharin is fused with a fragment of metallic sodium or potassium, it is converted into an alkali sulphide, which gives the well-known violet coloration with sodium nitroprusside.

VOGEL (*narceine*).—The substance is moistened with chlorine water, and shaken with a drop of ammonia solution. If narceine is present, a deep-red coloration is obtained.

VOGEL (*salts of cobalt*).—On treating a neutral or slightly-acid (acetic acid) solution of a cobalt salt with a strong solution of ammonium thiocyanate, a bright blue solution is obtained. If this is shaken with a mixture of 1 volume of amyl-alcohol and 10 to 15 volumes of ether, the supernatant amyl alcohol becomes blue. Sensitiveness = 0·02 mgrm. of cobalt.

VORTMANN (*hydrocyanic acid*).—When a liquid containing hydrocyanic acid is heated to boiling point with a few drops of potassium nitrite solution, 2 to 4 drops of ferric chloride solution, and 1 drop of sulphuric acid, then cooled, treated with ammonia and filtered, and the filtrate treated with ammonium sulphide, a violet coloration, due to the formation of sodium nitroprusside, is obtained.

VOURNASOS (*lactic acid in gastric juice*).—Five c.c. of the filtered gastric juice are rendered strongly alkaline with 10 per cent. potassium hydroxide

solution, boiled for ten minutes, and treated with 1 to 2 c.c. of a reagent prepared by dissolving 1 grm. of iodine, and 0·5 grm. of potassium iodide in 50 c.c. of water, filtering, and adding 5 grms. of methylamine to the filtrate. In the presence of lactic acid (down to 0·005 per cent.), the unpleasant odour of isonitrile is emitted.

VULPIUS (*sulphonal*).—When sulphonal is heated with potassium cyanide the odour of mercaptan is evolved, and on treating the fused mass with water, and adding ferric chloride solution, a blood-red coloration will be obtained.

W.

WAGNER-FRESENIUS (*alkaloids*).—This is the well-known reaction with a solution of potassium and mercuric iodides.

WÄNGERIN (*narcotine*).—A solution of 0·01 grm. of the substance in 20 drops of strong sulphuric acid is heated with 1 or 2 drops of a 1 per cent. solution of cane sugar, in a watch-glass, on the water-bath. In the presence of narcotine there is produced a greenish-yellow coloration, which changes successively to yellow, brownish-yellow, brown, violet-brown, and finally to brilliant violet-blue. Only this last coloration is distinctive of narcotine, since all the alkaloids react with strong sulphuric acid, giving similar colorations.

WÄNGERIN (*hydrastine*).—When hydrastine is heated on the water-bath with sulphuric acid and tannin, it gives a green coloration, which, when the mixture is cooled and again heated, changes to blue and then to dirty green, and finally yields a blackish precipitate.

WAUTHERS (*saccharin*).—When a small quantity of saccharin is heated with strong sulphuric acid

and resorcinol, a violet coloration, which is intensified on dilution with water, is obtained.

WEBER (*indican in urine*).—Thirty c.c. of the urine are boiled with an equal volume of hydrochloric acid and 1 to 3 drops of dilute nitric acid. In the presence of indican, the liquid becomes opaque, and, when cooled and shaken with ether, yields a red extract, changing to violet, whilst a blue froth forms on the surface of the ether.

WEBER-TOLLENS (*formaldehyde*).—On heating a solution of formaldehyde with strong hydrochloric acid and phloroglucinol, there separates a flocculent precipitate, which is first white and then yellowish-red.

WEIDEL (*xanthine*).—When xanthine is evaporated with chlorine water and a trace of nitric acid, it leaves a yellow residue, which, when treated with gaseous ammonia, becomes intense yellowish-red.

WEIGERT (*stain for bacteriology*).—This consists of a solution of 2·4 grms. of methylene blue, magenta, or victoria blue in 15 c.c. of alcohol, diluted to 100 c.c. with water.

WEIGERT-GRAHM (*stain for bacteriology*).—Twenty-five c.c. of a saturated alcholic solution of methyl violet or gentian violet are treated with 1 c.c. of aniline and 4 to 5 c.c. of absolute alcohol.

WELLCOME (*morphine*).—An aqueous solution of calcium chloride (1 : 8) gives a red coloration with morphine.

WELMANN (*vegetable oils*).—One c.c. of the sample is dissolved in 5 c.c. of chloroform, and shaken for a minute with 2 c.c. of an aqueous 5 per cent. solution of sodium phosphomolybdate acidified with nitric acid. If the fat contains vegetable oils, the mixture becomes green, the colour changing to blue on the addition of ammonia. Coconut oil and rancid oils do not give this reaction.

WELMANN (*santonine*).—Santonine (0·1 grm.) gives a blood-red coloration, changing to violet when treated with 2 c.c. of strong sulphuric acid and 2 drops of ferric chloride solution.

WENDER-NEUMANN (*dulcine*).—On treating a trace of dulcine with a few drops of fuming nitric acid, an energetic reaction takes place, yielding a yellow product, which, when evaporated to dryness, leaves a yellow residue soluble in ether, alcohol, and chloroform. When this residue is treated with 2 drops of phenol, and 2 drops of strong sulphuric acid, it gives a blood-red coloration, which does not alter on exposure to the air. The mass is soluble in chloroform, forming a red solution, the colour of which fades in a short time.

WENDER-NEUMANN (*dextrose*).—The reagent consists of a solution of 1 part of methylene blue in 3,000 parts of water. This solution is decolorised when rendered alkaline with potassium hydroxide, and heated with dextrose.

WENZELL (*alkaloids*).—The reagent is a solution of 1 grm. of potassium permanganate in 200 grms. of sulphuric acid. It gives various colorations with different alkaloids.

WEPPEN (*cevadine, veratrine*).—Sulphuric acid containing furfural gives a yellow coloration, changing to green and bright blue, with solutions of these substances.

WESELSKY (*phloroglucinol*).—On treating a solution of phloroglucinol with toluidine nitrate and potassium nitrite, a coloration is produced, which is first bright yellow, then opalescent, and finally orange and red.

WESELSKY (*olive oil*).—The reagent is prepared by saturating nitric acid (sp. gr. 1·25), chilled with ice, with the vapours developed by treating starch with nitric acid. It is used for the elaidin test (see POUTET).

WETZEL-KUNKEL (*carbon monoxide in blood*).—The blood is diluted with four times its volume of water, and treated with three times its volume of a 1 per cent. solution of tannin. In the presence of carbon monoxide, a carmine-red coloration is produced, whilst normal blood gradually turns grey.

WEYL (*creatinine in urine*).—Urine containing creatinine gives a ruby-red coloration, when treated with a dilute solution of sodium nitroprusside and with sodium hydroxide.

WIESNER (*lignin*).—(1) A dilute aqueous or alcoholic solution of phloroglucinol, followed by strong hydrochloric acid, imparts a cherry-red coloration to textile fibres containing lignin. (2) An aqueous solution of aniline sulphate (1 per cent.) gives a yellow coloration with lignin.

WIJS (*iodine absorption*).—Iodine monochloride solution, prepared by mixing 7·8 grms. of iodine trichloride, and 8·5 grms. of iodine per litre.

WITZ (*free mineral acids in vinegar and in gastric juice*).—A solution of 0·01 grm. of methyl violet in 100 c.c. of water becomes green in the presence of mineral acids.

WOLFF (*benzidine and toluidine*).—A small quantity of the substance is shaken in a test-tube with 1 c.c. of glacial acetic acid until dissolved, and the solution is diluted with sufficient water to fill three-fourths of the tube, and is then treated with a few drops of water containing lead dioxide in suspension. In the presence of benzidine or toluidine, a blue coloration is produced, which is permanent in the cold, but disappears on heating.

WOLFF (*naphthols*).—Naphthols when heated to 50° C. with chloroform and alcoholic potassium hydroxide solution, give a blue coloration, which changes to red on the addition of hydrochloric acid.

WORM-MÜLLER (*dextrose*).—This is a modification of Fehling's solution, consisting in the use of different proportions of the constituents.

WREVEN (*tassine*).—A few drops of the ethereal solution of the alkaloid are allowed to evaporate on a porcelain tile, and the residue is treated with 1 or 2 drops of strong sulphuric acid. The streaks, which are thus produced, are of a fine purple-red colour when tassine is present.

WRIGHT (*aconitine*).—When 0·001 grm. of aconitine is mixed with a few drops of a solution of sugar of medium strength, and a drop of strong sulphuric acid is added, there is produced at the point of contact of the liquid a red zone, which changes rapidly to violet, and then to dirty blue.

WÜRSTER (*nitrous acid*).—The test is a modification of Griess's reaction, in which an acid solution of ammonium acetate is used in place of dilute sulphuric acid.

WÜRSTER (*tyrosine*).—On treating a boiling aqueous solution of tyrosine with 1 per cent. acetic acid and with a solution of sodium nitrate, a red coloration is obtained.

Y.

YOUNG (*gallic and tannic acids*).—When 1 c.c. of a 3 per cent. solution of potassium cyanide is added to 1 c.c. of a solution of gallic acid, it produces a ruby-red colour, which disappears after some time, but reappears, after a while, on shaking the liquid. Tannic acid and pyrogallic acid give a yellowish-red colour under these conditions.

YVON (*alkaloids*).—Three grms. of bismuth subnitrate are boiled with 40 c.c. of water, and 14 grms. of potassium iodide and 40 drops of

hydrochloric acid are added. This reagent gives colorations or red precipitates with alkaloids.

YVON (*urea*).—See HÜFFNER.

Z.

ZALESKI (*carbon monoxide in blood*).—Two c.c. of the blood are mixed with 2 c.c. of water, and treated with 3 drops of a saturated solution of copper sulphate. In the presence of carbon monoxide, a red coloration is obtained, whilst normal blood becomes greenish-brown.

ZEISEL (*colchicine*).—When a solution of 2 mgrms. of colchicine in 5 c.c. of water is heated for two to three minutes, over a small flame, with 5 to 10 drops of hydrochloric acid and 4 to 6 drops of a 10 per cent. solution of ferric chloride, it gradually becomes olive-green, the liquid ultimately becoming dark green and turbid. When this liquid is shaken with chloroform, a ruby-red extract separates, whilst the supernatant liquid is olive-green.

ZENKER (*fixative solution for microscopy*).—This consists of 5 grms. of mercuric chloride, 2·5 grms. of potassium bichromate, and 1 grm. of sodium sulphate in 100 c.c. of water. A few drops of acetic acid are added to it before use.

ZIEHL (*stain for bacteriology*).—This consists of 1 grm. of magenta, 10 grms. of absolute alcohol, and 5 grms. of crystalline phenol in 100 c.c. of water.

ZULSER (*albumin*).—A strong solution of chromic acid gives a precipitate with liquids containing albumin.

ZWENGER (*cholesterol*).—On treating a crystal of cholesterol with a mixture of 5 parts of sulphuric acid and 1 part of water, a red ring, changing to violet, is obtained.

TEST PAPERS.

TEST-PAPERS are of considerable use in volumetric analysis, and in many special cases of clinical or toxicological research, especially those involving reactions in which gas is evolved, or readily volatile substances are produced. For the preparation of test-papers, filter-paper of the best quality is used; it is washed, first with dilute hydrochloric acid, then with very dilute ammonia solution, and finally with water, until the washings are neutral.

The paper thus treated is immersed in a solution of the indicator, and is then suspended on glass rods to dry in the air, in a place protected from light and free from dust. As soon as the paper is perfectly dry, it is cut into strips, and kept in well-closed bottles of coloured glass. Test-papers may be classified into three groups in accordance with their use :—

1. General test papers for acids and bases.
2. Test-papers for special reactions.
3. Papers for clinical tests.

GENERAL TEST-PAPER FOR ACIDS AND BASES.

ALKANINE PAPER.—The paper is impregnated with a 3 per cent. alcoholic solution of alkanine, or with the ethereal extract of the alkanet root. When dry it is pink. In the presence of alkalies it changes to green or blue, whilst acids turn it red again.

ALKANINE (BLUE) PAPER.—This is prepared by dipping the red paper, made as described

above, into a 1 per cent. solution of sodium carbonate. It is sensitive to a hydrochloric acid solution of 1 : 80,000, and to sulphuric acid of 1 : 60,000.

Azolitmus Paper.—The paper is impregnated with a solution of 1 part of azolitmus and 1 part of sodium carbonate in a litre of water, with the addition of just sufficient phosphoric acid to make the liquid red. It gives a blue coloration with alkalies and a red coloration with acids.

Brazil Wood Paper.—The paper is immersed in an extract of Brazil wood. It is coloured carmine-red by alkalies, and decolorised by acids.

Carmine-red Paper.—Paper impregnated with an ammoniacal solution of carmine-red serves as an indicator for acids, which change its colour to yellowish-red.

Cochineal Paper.—The paper is immersed in cochineal tincture. It is coloured yellowish-red by acids, and violet by alkalies. It is very sensitive.

Congo Red Paper (*Herzberg*).—The paper is impregnated with a 0·1 per cent. solution of Congo red in 30 per cent. alcohol. Its colour is changed to blue by acids, whilst alkalies restore the red colour.

Dahlia Paper (*antocyanine, georgina*).—This is prepared by immersing the paper in an alcoholic extract of the corollæ of *Georgina purpurea*. When dry it is of a bluish-violet colour, which is changed to red by acids, and to green by alkalies.

Fluorescein Paper (*Zellner*).—This paper is prepared in a special way. The basis consists of a neutral black pigment, and upon this is placed a solution of fluorescein made into an emulsion with an alcoholic solution of a resin. On treating the paper with alkali, *e.g.*, a minute trace of ammonia, it produces a fine green fluorescent

reaction, which is very distinct on the dark groundwork.

Hæmatoxylin Paper.—The paper is washed, first with dilute hydrochloric acid, and then with water, and is immersed in a solution prepared by digesting 10 parts of logwood for several hours with 40 parts of alcohol and 120 parts of water. The liquid is heated with 0·7 part of alum (free from iron) and 7 parts of calcium chloride, dissolved in the smallest possible amount of water acidified with hydrochloric acid, which is added drop by drop until a red coloration sufficient to tint the paper is obtained. When dry, the paper is slightly yellow or pink. In the presence of alkalies, it becomes blue. It is extremely sensitive to ammonia.

Lacmoid (or Resorcinol Blue) Paper.—Lacmoid is prepared by heating resorcinol with sodium nitrite at a moderate temperature. It is soluble in alcohol (0·2 grm. in 100 c.c.), and the alcoholic solution is used for impregnating the paper. It is coloured red by acids, and blue by bases. It is a good reagent for strong acids and bases, and for ammonia, but is not suitable for weak acids and for nitrous acid.

Litmus Paper.—100 grms. of litmus are powdered, and extracted, first for half an hour with 500 grms. of hot 95 per cent. alcohol, and then with two successive portions of 250 grms. of the hot alcohol, for thirty minutes each time. The residue is digested for twenty-four hours with 1 litre of distilled water. The extract is filtered through cotton-wool, and the filtrate is divided into two parts. One of these is treated with dilute phosphoric acid until it becomes red. The second portion is then treated with the same acid, and added to the first, and the whole is allowed to stand. It is filtered from the deposit, and used for the impregnation of filter-paper. Litmus

paper turns red with acids, and blue with alkalies.

Magenta Paper.—The paper is immersed in a solution of magenta, to which has been added sulphuric acid until a yellowish-brown coloration is obtained. When dry, the paper is yellow, and extremely sensitive to ammonia, which changes its colour to carmine-red.

Marshmallow Paper (*Stevenin*).—The paper is immersed in an extract prepared by macerating 20 parts of the flowers of *Altea rosea* with a mixture of 100 parts of water, 900 parts of alcohol, and 1 part of ammonia solution. The paper becomes bluish-green on contact with alkali, whilst acid turns it red.

Methyl Orange or (Helianthin) Paper.—The paper is impregnated with an aqueous solution of methyl orange, obtained by dissolving 0·02 grm. of the dyestuff in 100 c.c. of boiling water, and filtering the liquid. The paper becomes orange-red with acids, and yellow with bases. It is particularly suitable for strong acids, and for phosphoric and sulphurous acids. Weak mineral and organic acids do not react with it. Strong bases, and notably amino-organic bases, give a good reaction.

Methyl Violet Paper.—The paper is impregnated with an aqueous solution of methyl violet (1 : 200). When dry, the paper is violet. It is changed to green or yellowish-green by strong acids, whilst bases restore the violet colour. Acetic acid does not affect this test-paper.

Phenolphthalein Paper.—The paper is immersed in a 1 per cent. solution of phenolphthalein in 96 per cent. alcohol. It becomes red with alkalies, and is decolorised again by acids. It is particularly suitable for strong acids and bases, but cannot be used with ammonia.

Rosolic Acid Paper.—The paper is impregnated

with a neutral 0·2 per cent. alcoholic solution of rosolic acid. In the presence of strong acids or of carbonic acid the paper becomes yellow, whilst alkalies, baryta water, and alkali carbonates turn it red. The presence of ammonium salts modifies the reaction, and affects the sensitiveness of the paper.

Tropæolin Paper (*Boas-Lücke*).—The paper is immersed in a 0·1 per cent. alcoholic solution of tropæolin OO. It gives a red coloration with acids, and a yellow coloration with alkalies. It is suitable for oxalic acid and other organic acids, and is not affected by carbonic acid.

Turmeric Paper.—This is prepared by impregnating the paper with an alcoholic solution of turmeric. It is an indicator for caustic alkalies, which turn it reddish-brown. It gives a rose-brown coloration with boric acid.

Turmeric (Curcumine) Paper.—This behaves in the same way as the preceding paper. It is prepared by immersing the paper in an alcoholic solution of curcumine. It is particularly suitable for the detection of minute quantities of boric acid.

PAPERS FOR SPECIAL TESTS.

Copper Sulphate and Guaiacum Tincture Paper.—The paper is impregnated with a 1 per cent. alcoholic solution of guaiacum resin and dried, and is then dipped in a solution of copper sulphate (1 : 2,000). In the presence of hydrocyanic acid it turns blue (*Schönbein* and *Pagenstecker*).

Gold Chloride Paper (*ozone*).—A paper impregnated with gold chloride becomes violet in the presence of ozone (Böttger).

Indigo Paper (*oxygen*).—The paper is impreg-

nated with a solution of indigo. It is used for the detection of oxygen.

LEAD ACETATE PAPER (*hydrogen sulphide*).—The paper is immersed in a 10 per cent. solution of lead acetate. It is darkened on contact with hydrogen sulphide.

METAPHENYLENEDIAMINE PAPER (*Griess's yellow paper*).—The paper is impregnated with an alcoholic solution of metaphenylenediamine. It is coloured yellow or brown by nitrous acid or nitrites.

NAPTHYLAMINE PAPER (*Griess's red paper*).—The paper is immersed in an alcoholic solution of sulphanilic acid and of α-naphthylamine hydrochloride. It becomes pink on contact with nitrous acid or nitrates.

PALLADIUM CHLORIDE PAPER (*reducing substances*).—This is a paper saturated with a solution (1 : 12) of palladous sodium chloride. It is turned black by reducing substances, such as carbon monoxide.

SCHIFF'S PAPER (*dextrose and carbohydrates*).—The paper is impregnated with a mixture in equal volumes of glacial acetic acid and xylene, with the smallest possible amount of alcohol. The substance under examination is first heated with sulphuric acid, and, if it contains dextrose or other carbohydrates, it will then give a red coloration to the paper.

SILVER PAPER (*Schiff*).—This is used for the detection of arsenic (yellow coloration), phosphorus (black), and uric acid (brown coloration).

STARCH IODIDE PAPER (*oxidising substances*).—One part of starch is boiled with 100 parts of water and filtered, and 5 parts of potassium iodide are dissolved in the filtrate. Paper impregnated with this solution becomes blue when applied to oxidising substances, such as chlorine, chloric acid, iodic acid, bromic acid, and ozone.

TETRAMETHYL-*p*-PHENYLENEDIAMINE PAPER (*ozone, hydrogen peroxide, nascent oxygen*).—Paper impregnated with this substance gives an intense violet-blue coloration on contact with ozone, hydrogen peroxide, or nascent oxygen in neutral or acetic acid solution. When the paper thus coloured is boiled with alcohol, it is decolorised (*Wurster*).

THALLIUM PAPER (*ozone*).—The paper is saturated with a 10 per cent. solution of thallium hydroxide obtained by treating a solution of thallium sulphate with baryta water. It becomes brown on contact with ozone.

PAPERS FOR CLINICAL TESTS.

ACIDS IN GASTRIC JUICE (*Boas-Lücke*).—This is tropæolin paper. It becomes red when treated with free hydrochloric or lactic acids.

ALBUMIN (GEISSLER).—(1) *Potassium Mercury Iodide and Citric Acid Papers.*—The paper is saturated with a strong solution of citric acid, whilst other strips are immersed in a solution containing 3 per cent. of mercuric chloride and 15 per cent. of potassium iodide. For the detection of albumin in urine, the sample is first treated with the citric acid paper and then with the iodide paper. In the presence of albumin, a precipitate is formed.

(2) *Citric and Picric Acid Paper* (*Olliver*).—The paper is impregnated with a 2 per cent. solution of these acids. When it is introduced into urine containing albumin a precipitate is formed.

(3) *Sodium Tungstate and Citric Acid Paper* (*Olliver*).—The paper is immersed in a concentrated solution of these substances. When introduced into albuminous urine, it yields a precipitate. A precipitate is also formed in the

presence of mucine, creatinine, peptones, and uric acid.

(4) *Potassium Mercuric Iodide Paper* (*Hoffmann*).—The paper is impregnated with a mixture composed of a 50 per cent. solution of potassium iodide and of a 5 per cent. solution of mercuric chloride. On introducing strips of this paper into albuminous urine, previously acidified with acetic acid, a precipitate is obtained.

(5) *Potassium Ferrocyanide and Citric Acid Papers.*—Two papers are used, impregnated respectively with potassium ferrocyanide and with citric acid. Introduced into albuminous urine they produce a precipitate.

Phloroglucinol-Vanillin Paper (*Gunzburg*).—This may be used for the detection of lignin in paper, and also of free hydrochloric acid in gastric juice. It is prepared by saturating filter paper with a solution of 1 part of phloroglucinol and 2 parts of vanillin in 30 parts of alcohol. It is coloured red by hydrochloric acid, or by lignin.

Sugar in Urine (*Olliver*).—Two papers are used, impregnated respectively with a solution of indigo-carmine and of sodium carbonate. In the presence of dextrose, these papers, when introduced into the urine, give successively a reddish-green and yellow colorations.

COLLECTIVE INDEX OF REAGENTS AND REACTIONS OF DIFFERENT SUBSTANCES.

A.

Abrastol. — Brand — Sangle, Ferriere — Sanna, Pintus.
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Acetanilide.—Rittsert.
Acetone. — Chautard — Dennigés — Ehrlich — Ellram — Gunning — Legal — Le Noble — Lieben — Malerba — Messinger — Pentzold — Reynold—Rimini—Vitali.
Aceto-acetic Acid. — Arnold — Denigés — Gerhardt —Oudreyovich—Riegler.
Aconitine.—Herbst—Wright.
Adrenaline. — Aller, Fränkel — Ewins — Gunn — Harrison—Kurt-Boas.
Albumin. — Almen — Alpers — Bödecker — Carrez — Christensen — Cohen — Esbach — Fürbringer — Galippe — Gauthier — Gouver — Guerin — Hammarsten — Heller — Hilger — Jaworowsky — Jolles — Lugol — MacWilliam — Mankiewicz — Mehu — Panum — Pollacci — Possner — Raabe — Riegler — Rose — Rosenbach — Spiegler — Strzyzowscky — Tanret — Zulser.
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Alkali (Caustic).—Dobbin.
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Anilides.—Denigés.

Aniline. — Beissenhirtz — Duflos — Hoffmann — Jacquenin — Letheby — Runge — Vitali.

Antipyrine. — Bougault — Carrez — Knorr.

Apiol.—Jorissen.

Apomorphine.—Grimbert —Schmidt.

Arachis Oil.—Renard.

Arbutine.—Dahnon.

Arsenic. — Bettendorf — Denigés — Gosio — Gutzeit — Marsh — Reinsch — Schlickum.

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B.

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Benzanilide.—Mussi.
Benzidine.—Wolff.
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Biliary Acids.—Bischoff—Dragendorff—Drechsel—Kulz—Mylius—Neebauer—Pettenkofer—Udransky—Vitali.
Biliary Pigments.—Biffi—Capranica—Cunisset—Dragendorff—Drechsel—Fleischl—Fröhde—Gerhardt—Gluzinsky—Gmelin—Hammarsten—Hilger—Hoppe Seyler—Huppert—Jaksch—Jolles—Kathrein—Le Noble—Marechal—Paul—Rosenbach—Rosin—Schlesinger—Smith—Stokwis—Ultzmann.
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Bismuth (Salts of).—Schneider.
Bitter-Almond Water.—Daclin.
Blood—Almen—Baecchi—Bremer—Deen (van)—Donogany—Falk—Gannther—Heller—Hühnenfeld—Lechini—Schaer—Schlesinger, Holst—Selmi—Sonnenschein—Struve—Teichmann—Ultz.
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C.

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Cellulose.—Cutolo—Molisch—Schultze—Schweitzer.

Cerium (Salts of).—Plugge.
Cevadine.—Weppen.
Chloral.—Jaworowsky — Ogston — Reuter.
Chlorates.—Denigés.
Chloroform.—Dupony — Hoffmann — Neebauer — Schwarz—Vitali.
Chromic Acid.—Donath—Caro—Fischer.
Chrysarobine.—Leger.
Chrysophanic Acid.—Leger.
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Cistine.—Baumann, Goldmann — Liebig — Müller.
Citric Acid.—Chapman, Smith — Denigés — Haussler — Mann — Pusch — Sabanin, Laskowsky—Stahre.
Cobalt (Salts of).—Caro, Fischer — Donath — Fischer — Pagel — Rusting — Skey — Tattersall—Thenard—Vogel.
Cocaine.—Biel — Flückiger — Geitherr — Giesel — Kuborne — Metzger — Schäffer — Schärge—Silva (Ferreira da)—Szankay.
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Colchicine.—Kippenberger—Zeisel.
Colza Oil.—Schneider.
Coniine.—Melzer—Selmi.
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Copper (Salts of).—Aliamet — Bach — Denigés — Jaworowsky—Pagenstecker.
Coriander Seed.—Uffelmann.
Cotton Oil.—Bechi — Conroy — Deiss, Gannther — Halphen — Hirschsohn — Labiche — Milliau.
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D.

Dextrose.—Agostini — Allen — Almen — Baeyer — Barfold — Böttger — Braun — Bremer — Brücke — Campani — Crismer — Criswell — Degener — Drechsel — Dudley — Duyk — Einhorn — Fehling — Gaud — Gause — Gentelè — Gerrard — Hager, Gawalowsky — Haines — Hoppe Seyler — Ihl — Jaksch — Jaworowsky — Johnson — Lehmann — Leismer — Löwe — Löwenthal — Maumenè — Moore — Mulder — Nylander — Ost — Pavy — Pelouze — Pentzold — Polliti — Rosenbach — Rubner — Schiff — Schmidt — Soldaini — Tollens — Trommer.
Diazo Reaction.—Ehrlich.
Digitaleine.—Grandeau—Kiliani.
Digitalis.—Brissemoret, Derrien.
Digitaline.—Grandeau—Lafon.
Digitonine.—Keller.
Digitoxine.—Kiliani.
Dulcine.—Berlinerblau — Jorissen — Morpurgo — Ruggeri — Thomas—Wender.
Dyestuffs (Coal-tar).—Arata — Blarez — Böttger — Cazeneuve — Cottini, Fantogini — Debrun — Faure — Girard.

E.

Ergot of Rye.—Hoffmann.
Ergotine.—Keller.
Erithrosclerotine.—Dragendorff, Podwyssotzki.
Eserine.—Silva (Ferreira da).
Essences (Aromatic).—Arznberger—Fabris.
Essential Oils.—Duyk—Fabris.

Ether.—Jorissen.
Ethyl Sulphide.—Liebermann.
Eugenol.—Chapman.

F.

Fats.—See *Oils.*
Fatty Acids.—Jacobsen.
Flesh.—Bräutigam, Edelmann—Eber.
Flour.—Hoffmann—Uffelmann.
Fibres (Textile).—Böttger — Jacquemin — Overbech — Peligot — Schlossberger — Schweitzer.
Formaldehyde.—Goldschmidt — Hehner — Jorissen — Judd — Kentmann — Leblin — Mitchell — Neuberg — Pilhastry — Pollacci — Riegler — Rimini — Schryver — Therenon — Todtenhaupt —Trillat—Weber, Tollens.
Fruit Acids.—Mitchell.
Fusel Oil.—Jorissen.

G.

Gallic Acid.—David—Dudley—Young.
Gastric Juice.—Arnold—Boas—Cohn, Mehring — Contejean — Ewald — Günzburg — Jager (de)— Jaksch — Mohr — Rabuteau — Schuchardt — Töpfer — Uffelmann — Velden (van der) — Vournasos—Witz.
Glycerin.—Böttger—Grünhat—Kohn — Reich — Senier—Löwe.
Glycogen.—Best—Knapp.
Guaiacol.—Jaworowsky.
Gum Ammoniacum.—Plugge.
Guanine.—Capranica.

H.

Hæmatin.—Podwyssotzki.
Hæmoglobin.—Ladendorf.

Hexoses.—Rasmussen.
Hippuric Acid.—Lücke.
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Hydrogen Peroxide. — Bach — Barralet — Böttger — Denigés — Ilosvay — Schönbein — Vanino Seemann.
Hydrogen Sulphide. — Caro, Fischer — Curtmann — Fischer — Ganassini — Kral — Lauth.
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Hypoxanthine.—Kossel.

I.

Indican. — Ehrlich — Hammarsten, Jaffè — Klett — Loubiou — MacMunn — Obermayer — Weber.
Indol — Baeyer — Kitasato, Salkowski — Legal — Nencki.
Inosite.—Gallois—Scherer—Seidel.
Iodine.—Alfraise—Sadlund.
Iodine Absorption.—Hanus — Hübl (von) — Wijs.
Iodoform.—Lustgarten—Vitali.
Iron (Salts of).—Denigés.
Isoeugenol.—Chapman.
Isosafrol.—Chapman.

L.

Lactic Acid. — Arnold — Boas — Uffelmann — Vournasos.
Lactose.—Rubner.
Lævulose.—Seliwanoff.
Lecithin.—Orlow.

Leucine.—Hoffmeister.
Lignin. — Dahlmann — Hegler — Höhnel (von) — Piutti — Wiesner.

M.

Malic Acid.—Hilger.
Manganese (Salts of).—Crum—Denigés.
Melanin.—Eiselt—Jaksch—Thormahlen.
Melanogen.—Jaksch.
Mercaptans.—Denigés.
Mercury.—Gaglio—Jolles.
Methæmoglobin.—Kobert.
Methyl Alcohol. — Denigés, Mulliken, Scudder.
Microscopy (Stains for). — Böhmer — Croker — Czokor — Delafield — Dural — Ehrlich — Erliki — Fol — Frey — Gibbe — Giemsa — Golgi — Grenacher — Hanstein — Kleinenberg — Nicolle — Pacini — Pappenheim — Rable — Sahli — Schlutze — Zenker.
Milk. — Dupony — Ostertag, Arnold — Schäffer —Storch.
Mineral Acids. — Egger — Hager — Hüber — Jager — Payen — Witz.
Mineral Oils. — Demski, Morawski.
Morphine. — Bruylants — Chastaing, Barrilot — Flückiger — Husemann — Jorissen — Kerner — Kobert — Lamal — Otto — Pellagri — Robinet Schaer — Tattersall — Wellcome.
Mustard Oil.—Colasanti.

N.

Naphthalene.—Pentzold.
Naphthols. — Aymonier — Leger — Richardson — Wolff.
Narceine.—Arnold—Vogel.
Narcotine. — Cuerbe — Dragendorff — Wängerin.
Nataloine.—Histed.

Nickel (Salts of). — Grossmann — Tschugaeff.
Nicotine. — Roussin — Schindelmeister — Selmi.
Nitric Acid. –Alessandri, Ganassini — Boussingault — Braun — Curtmann — Denigés — Dessbassin — Hoffmann — Horsley — Ince — Lindo — Longi — Pollack — Reichardt — Sprengel.
Nitrous Acid. — Alessandri, Ganassini — Armani, Barboni — Böttger — Buywid — Curtmann — Denigés — Erdmann — Frankland — Grandval, Layoux — Griess — Ilosvay — Jorissen — Lindo — Lunge — Manseau — Riegler — Schäffer — Schäffer, Schuyten—Trommsdorff—Würster.

O.

Oils and Fats: Olive Oil.—Barbot — Basch — Baudouin — Bechi — Behrens — Bellier — Bieber — Bishop — Boudet — Brullè — Cailletet — Camoin — Conroy — Crace Calvert — Deiss — De Vetere - Ferraro — Gassend — Halphen —Hauchecorne — Heydenreich — Labiche — Lewin — Milliau — Penot — Poutet — Renard — Schneider — Soltsien - Storch, Morawski — Tambon — Tocher — Tortelli, Ruggeri — Villavecchia, Fabris — Wellmann — Weselsky.
Oxydases.—Meyer—Schmidt.
Ozone. –Erlwein, Weyl—Manchot, Kampeschultz —Schönbein.

P.

Papaverine.—Tattersall.
Peach Oil.—Nicklés.
Pentosans.—Salkowski.
Pentoses.—Bial—Tollens.
Peptones. — Devoto — Gorup, Besanez — Possner —Salkowski.
Persulphates.—Caro.
Phenacetin.—Crinon—Ritsert.

Phenol. — Arnold, Werner — Berthelot — Bodde — Cotton — Davy — Desesquelle — Eykmann — Guareschi — Hoffmann — Hoppe Seyler — Jacquemin — Landolt — Lex — Melzer — Pentzold, Fischer — Pollacci — Salkowski — Tommasi — Udranszky.
Phenols. — Allen — Endemann — Fresenius — Lambert — Liebermann — Millon — Plugge.
Phloridzine.—Nickel.
Phloroglucinol.—Weselsky.
Phosphorus.—Dusart, Blondot—Scherer.
Picric Acid.—Christel—Swoboda.
Picrotoxine.—Melzer — Minowic — Oglialoro — Otto.
Pilocarpine.—Lenz.
Potassium (Salts of).—Carnot.
Proteins. — Adamkiewicz — Axenfeld — Berzelius — Brücke — Krasser — Liebermann — Mulder —Petri — Piotrowski — Raffaele — Raspail — Reichl — Schultze.
Ptomaines.—Brouardel, Boutmy.
Pus.—Day.
Pyramidon.—Jolles.
Pyridine.—Anderson.
Pyrocatechol.—Ebstein, Müller.

Q.

Quinidine.—Brand—Hirschsohn.
Quinine.—Brand — De Vry — Eibart — Flückiger — Grahe — Herapath — Hirschsohn — Jaworowsky — Kerner — Pollacci.
Quinoline.—Anderson.
Quinuric Acid.—Jaffé.

R.

Resins.—Donath.
Resin Oil.—Cornette — Demski, Morawski — Storch, Morawski.

Resorcinol.—Bodde—Ferraro—Torti.
Rhubarb.—Prosch.

S.

Saccharin.—Börnstein — Kastle — Leys — Lindo — Pinette, Schmidt — Possetto, Issoglio — Schmidt — Tortelli, Piazza — Vitali, Muhler — Wauthers.
Safrol.—Chapman.
Saffron.—Kraemer.
Salicylic Acid.—Bodde — Cenci — Van Itallie — Jorissen — Schultz.
Salophen.—Goldmann.
Salvarsan.—Abelin.
Santonine.—Crouzel — Daclin — Ferraro — Jaworowsky — Neuhaus — Reichard — Theater—Wellmann.
Scatol.—Amand — Ciamician, Magnanini — Udranszky.
Sesamé Oil.—Basch — Baudouin — Bellier — Bishop — Bremer — Camoin — Flückiger, Behrens — Gassend — Lewin — Soltsien — Tambon — Focher — Villavecchia, Fabris.
Silk.—Hermann—Löwe—Truchot.
Solanine.—Bauer—Clarus—Stroppa.
Sparteine.—Marque.
Sperm (*Stains*).—Florence.
Strychnine.—Allen—Malaquin—Otto—Tafel.
Sucrol.—See *Dulcine.*
Sugars.—Böttger — Conrady — Fischer — Hager —Ihl — Mathieu, Plessy — Molisch — Neubauer Vogel—Reich—Riegler.
Sulphonal.—Rittsert—Schwarz—Vitali—Vulpius.

T.

Tannic Acid.—Gardiner—Young.
Tannin.—Baeme—Carpene—David.

Tartaric Acid.—Cailletet — Campbell, Starch — Chapman, Smith — Crismer — Denigés — Fenton — Ganassini — Mohler — Pusch.
Tassine.—Wreven.
Thiocyanic Acid.—Colasanti—Ellram.
Thiophen.—Denigés—Meyer.
Tin (Salts of).—Denigés—Rogiers.
Turpentine Oil.—Fabris.
Toluidine.—Wolff.
Tyrosine.—Denigés — Hoffmann — Piria, Staedeler —Scherer—Udranszky—Würster.

U.

Uranium (Salts of).—Crolas, Ducker.
Urea.—Hüffner, Knopp — Liebig — Schiff — Yvon.
Urethane.—Jacquemin.
Uric Acid.—Denigés — Dieterich — Focker — Gigli — Jaksch — Offer — Riegler — Schiff.
Urine.—Abelin — Agostini — Almen — Alpers — Amand — Arnold — Biffi — Bischoff — Bödecker — Böttger — Campani — Capranica — Carrez — Chautard — Christensen — Cohen — Crismer — Criswell — Crouzel — Cunisset — Daclin — Day —Degener — Denigés —Desesquelle — Devoto— Donogany — Dragendorff — Drechsel — Ebstein, Müller — Ehrlich — Eiselt — Ellram — Esbach — Fehling — Fleischl — Focker — Fröhde — Furbringer — Galippe — Gallois — Gand — Gerhardt — Gerrard — Gluzinsky — Gmelin — Guerin — Hammarsten — Heller — Hilger — Hoppe Seyler — Hüfner — Hühnenfeld — Huppert — Ihl — Jaksch — Jaquemin — Jaworowsky — Johnson — Jolles — Kathrein — Kerner — Klett — Knopp — Krehbil — Kulz — Lechini — Legal — Le Noble — Leismer — Lieben — Liebermann — Liebig — Löwenthal —

Lugol — MacMunn — MacWilliam — Marechal — Mehu — Messinger — Müller — Mylius — Neebauer - Nencki — Nylander — Obermayer — Oudreyovich - Panum — Paul — Pavy — Pentzold — Pettenkofer — Possner — Prosch — Raabe - Riegler — Roman, Delluc — Rose — Rosenbach — Rosin - Sadlund — Saillet — Salkowski — Schäffer - Schiff — Schlesinger — Schmidt — Smith — Soldaini — Spiegler — Struve — Strzyzowscky — Tanret — Thormahlen — Tollens — Trommer — Udranszky — Ultzmann — Vitali — Weber — Weyl — Yvon— Zulser.

Urobilin.—Jaffè — Roman, Delluc — Schmidt.

Urobilinogen.—Saillet.

V.

Vanadates.—Mitchell.

Vanillin. Bonnema Moerk—Nickel.

Vaseline.—Crouzel.

Veratrine. Ferraro - Lave — Schumpelitz Thomson—Trapp—Weppen.

Veronal.—Molle.

W.

Wax.—Donath.

Wine.—Arata — Blarez — Böttger — Brand — Carpenè — Cazeneuve — Cottini, Fantogini — Debrun - Faure — Girard — Sanglè, Ferriere — Sanna, Pintus.

X.

Xanthin.—Hoppe Seyler—Weidel.

Z.

Zinc (Salts of).—Rinnmann.

Table I.

INTERNATIONAL ATOMIC WEIGHTS.

Element.	Symbol.	Atomic Weight.	Element.	Symbol.	Atomic Weight.
Aluminium	Al	27·1	Neodymium	Nd	144·3
Antimony	Sb	120·2	Neon	Ne	20·2
Argon	A	39·88	Nickel	Ni	58·68
Arsenic	As	74·96	Niton (radium emanation)	Nt	222·4
Barium	Ba	137·37	Nitrogen	N	14·01
Bismuth	Bi	208·0	Osmium	Os	190·9
Boron	B	11·0	Oxygen	O	16·00
Bromine	Br	79·92	Palladium	Pd	106·7
Cadmium	Cd	112·40	Phosphorus	P	31·04
Cæsium	Cs	132·81	Platinum	Pt	195·2
Calcium	Ca	40·07	Potassium	K	39·10
Carbon	C	12·005	Praseodymium	Pr	140·9
Cerium	Ce	140·25	Radium	Ra	226·0
Chlorine	Cl	35·46	Rhodium	Rh	102·9
Chromium	Cr	52·0	Rubidium	Rb	85·45
Cobalt	Co	58·97	Ruthenium	Ru	101·7
Columbium	Cb	93·1	Samarium	Sa	150·4
Copper	Cu	63·57	Scandium	Sc	44·1
Dyprosium	Dy	162·5	Selenium	Se	79·2
Erbium	Er	167·7	Silicon	Si	28·3
Europium	Eu	152·0	Silver	Ag	107·88
Fluorine	F	19·0	Sodium	Na	23·00
Gadolinium	Gd	157·3	Strontium	Sr	87·63
Gallium	Ga	69·9	Sulphur	S	32·06
Germanium	Ge	72·5	Tantalum	Ta	181·5
Glucinum	Gl	9·1	Tellurium	Te	127·5
Gold	Au	197·2	Terbium	Tb	159·2
Helium	He	4·00	Thallium	Th	204·0
Holmium	Ho	163·5	Thorium	Th	232·4
Hydrogen	H	1·008	Thulium	Tm	168·5
Indium	In	114·8	Tin	Sn	118·7
Iodine	I	126·92	Titanium	Ti	48·1
Iridium	Ir	193·1	Tungsten	W	184·0
Iron	Fe	55·84	Uranium	U	238·2
Krypton	Kr	82·92	Vanadium	V	51·0
Lanthanum	La	139·0	Xenon	Xe	130·2
Lead	Pb	207·20	Ytterbium (Neo-ytterbium)	Yb	173·5
Lithium	Li	6·94	Yttrium	Yt	88·7
Lutecium	Lu	175·0	Zinc	Zn	65·37
Magnesium	Mg	24·32	Zirconium	Zr	90·6
Mercury	Hg	200·6			
Molybdenum	Mo	96·0			

TABLE II.

AQUEOUS SOLUTIONS OF AMMONIA (LUNGE-WIERNIK).

SPECIFIC GRAVITY AT 15° C. COMPARED WITH WATER AT 15° C. = 1.

Sp. gr.	NH_3 %	1 litre containing at 15° C. grms.	Correction per + 1° C.	Sp. gr.	NH %	1 litre containing at 15° C. grms.	Correction per + 1° C.
1·000	0·00	0·0	0·00018	0·940	15·63	146·9	0·00039
0·998	0·45	4·5	0·00018	0·938	16·22	152·1	0·00040
0·996	0·91	9·1	0·00019	0·936	16·82	157·4	0·00041
0·994	1·37	13·6	0·00019	0·934	17·42	162·7	0·00041
0·992	1·84	18·2	0·00020	0·932	18·03	168·1	0·00042
0·990	2·31	22·9	0·00020	0·930	18·64	173·7	0·00042
0·988	2·80	27·7	0·00021	0·928	19·25	178·6	0·00043
0·986	3·30	32·5	0·00021	0·926	19·87	184·2	0·00044
0·984	3·80	37·4	0·00022	0·924	20·49	189·3	0·00045
0·982	4·30	42·2	0·00022	0·922	21·12	194·7	0·00046
0·980	4·80	47·0	0·00023	0·920	21·75	200·1	0·00047
0·978	5·30	51·8	0·00023	0·918	22·39	205·6	0·00048
0·976	5·80	56·6	0·00024	0·916	23·03	210·9	0·00049
0·974	6·30	61·4	0·00024	0·914	23·68	216·3	0·00050
0·972	6·80	66·1	0·00025	0·912	24·33	221·9	0·00051
0·970	7·31	70·9	0·00025	0·910	24·99	227·4	0·00052
0·968	7·82	75·7	0·00026	0·908	25·65	232·9	0·00053
0·966	8·33	80·5	0·00026	0·906	26·31	238·3	0·00054
0·964	8·84	85·2	0·00027	0·904	26·98	243·9	0·00055
0·962	9·35	89·9	0·00028	0·902	27·65	249·4	0·00056
0·960	9·91	95·1	0·00029	0·900	28·33	255·0	0·00057
0·958	10·47	100·3	0·00030	0·898	29·01	260·5	0·00058
0·956	11·03	105·4	0·00031	0·896	29·69	266·0	0·00059
0·954	11·60	110·7	0·00032	0·894	30·37	271·5	0·00060
0·952	12·17	115·9	0·00033	0·892	31·05	277·0	0·00060
0·950	12·74	121·0	0·00034	0·890	31·75	282·6	0·00061
0·948	13·31	126·2	0·00035	0·888	32·50	288·6	0·00062
0·946	13·88	131·3	0·00036	0·886	33·25	294·6	0·00063
0·944	14·46	136·5	0·03037	0·884	34·10	301·4	0·00064
0·942	15·04	141·7	0·00038	0·882	34·95	308·3	0·00065

Table III.

AQUEOUS SOLUTIONS OF CAUSTIC POTASH AT 15° C. (Lunge).

Sp. Gr.	Degrees Baumé.	Degrees Twaddell	K_2O %.	KOH %.	Sp. Gr.	Degrees Baumé.	Degrees Twaddell.	K_2O %.	KOH %.
1·007	1	1·4	0·7	0·9	1·252	29	50·4	22·7	27·0
1·014	2	2·8	1·4	1·7	1·263	30	52·6	23·5	28·0
1·022	3	4·4	2·2	2·6	1·274	31	54·8	24·2	28·9
1·029	4	5·8	2·9	3·5	1·285	32	57·0	25·0	29·8
1·037	5	7·4	3·8	4·5	1·297	33	59·4	25·8	30·7
1·045	6	9·0	4·7	5·6	1·308	34	61·6	26·7	31·8
1·052	7	10·4	5·4	6·4	1·320	35	64·0	27·5	32·7
1·060	8	12·0	6·2	7·4	1·332	36	66·4	28·3	33·7
1·067	9	13·4	6·9	8·2	1·345	37	69·0	29·3	34·9
1·075	10	15·0	7·7	9·2	1·357	38	71·4	30·2	35·9
1·083	11	16·6	8·5	10·1	1·370	39	74·0	31·0	36·9
1·091	12	18·2	9·2	10·9	1·383	40	76·6	31·8	37·8
1·100	13	20·0	10·1	12·0	1·397	41	79·4	32·7	38·9
1·108	14	21·6	10·8	12·9	1·410	42	82·0	33·5	39·9
1·116	15	23·2	11·6	13·8	1·424	43	84·8	34·4	40·9
1·125	16	25·0	12·4	14·8	1·438	44	87·6	35·4	42·1
1·134	17	26·8	13·2	15·7	1·453	45	90·6	36·5	43·4
1·142	18	28·4	13·9	16·5	1·468	46	93·6	37·5	44·6
1·152	19	30·4	14·8	17·6	1·483	47	96·6	38·5	45·8
1·162	20	32·4	15·6	18·6	1·498	48	99·6	39·6	47·1
1·171	21	34·2	16·4	19·5	1·514	49	102·8	40·6	48·3
1·180	22	36·0	17·2	20·5	1·530	50	106·0	41·5	49·4
1·190	23	38·0	18·0	21·4	1·546	51	109·2	42·5	50·6
1·200	24	40·0	18·8	22·4	1·563	52	112·6	43·6	51·9
1·210	25	42·0	19·6	23·3	1·580	53	116·0	44·7	53·2
1·220	26	44·0	20·3	24·2	1·597	54	119·4	45·8	54·5
1·231	27	46·2	21·1	25·1	1·615	55	123·0	47·0	55·9
1·241	28	48·2	21·9	26·1	1·634	56	126·8	48·3	57·5

TABLE IV.

AQUEOUS SOLUTIONS OF CAUSTIC SODA AT 15° C. (LUNGE).

Sp. Gr.	Degrees Baumé.	Degrees Twaddell.	Na_2O %	NaOH %	Sp. Gr.	Degrees Baumé.	Degrees Twaddell.	Na_2O %	NaOH %
1·007	1	1·4	0·47	0·61	1·220	26	44·0	15·18	19·58
1·014	2	2·8	0·93	1·20	1·231	27	46·2	15·96	20·59
1·022	3	4·4	1·55	2·00	1·241	28	48·2	16·76	21·42
1·029	4	5·8	2·10	2·71	1·252	29	50·4	17·55	22·64
1·036	5	7·2	2·60	3·35	1·263	30	52·6	18·35	23·67
1·045	6	0·9	3·10	4·00	1·274	31	54·8	19·23	24·81
1·052	7	10·4	3·60	4·64	1·285	32	57·0	20·00	25·80
1·060	8	12·0	4·10	5·29	1·297	33	59·4	20·80	26·83
1·067	9	13·4	4·55	5·87	1·308	34	61·6	21·55	27·80
1·075	10	15·0	5·08	6·55	1·320	35	64·0	22·35	28·83
1·083	11	16·6	5·67	7·31	1·332	36	66·4	23·20	29·93
1·091	12	18·2	6·20	8·00	1·345	37	69·0	24·20	31·22
1·100	13	20·0	6·73	8·68	1·357	38	71·4	25·17	32·47
1·108	14	21·6	7·30	9·42	1·370	39	74·0	26·12	33·69
1·116	15	23·2	7·80	10·06	1·383	40	76·6	27·10	34·96
1·125	16	25·0	8·50	10·97	1·397	41	79·4	28·10	36·25
1·134	17	26·8	9·18	11·84	1·410	42	82·0	29·05	37·47
1·142	18	28·4	9·80	12·64	1·424	43	84·8	30·08	38·80
1·152	19	30·4	10·50	13·55	1·438	44	87·6	31·00	39·99
1·162	20	32·4	11·14	14·37	1·453	45	90·6	32·10	41·41
1·171	21	34·2	11·73	15·13	1·468	46	93·6	33·20	42·83
1·180	22	36·0	12·33	15·91	1·483	47	96·6	34·40	44·38
1·190	23	38·0	13·00	16·77	1·498	48	99·6	35·70	46·15
1·200	24	40·0	13·70	17·67	1·514	49	102·8	36·90	47·60
1·210	25	42·0	14·40	18·58	1·530	50	106·0	38·00	49·02

Tables V. and VI.

POTASSIUM CARBONATE AT 15° C. (Gerlach).

Sp. Gr.	K_2CO_3 %.	Sp. Gr.	K_2CO_3 %.	Sp. Gr.	K_2CO_3 %.
1·00914	1	1·18265	19	1·38279	37
1·01829	2	1·19286	20	1·39476	38
1·02743	3	1·20344	21	1·40673	39
1·03658	4	1·21402	22	1·41870	40
1·04572	5	1·22459	23	1·43104	41
1·05513	6	1·23517	24	1·44338	42
1·06454	7	1·24575	25	1·45573	43
1·07396	8	1·25681	26	1·46807	44
1·08337	9	1·25787	27	1·48041	45
1·09278	10	1·27893	28	1·49314	46
1·10258	11	1·28999	29	1·50588	47
1·11238	12	1·30105	30	1·51861	48
1·12219	13	1·31261	31	1·53135	49
1·13199	14	1·32417	32	1·54408	50
1·14179	15	1·33573	33	1·55728	51
1·15200	16	1·34729	34	1·57048	52
1·16222	17	1·35885	35	1·57079	51·024
1·17243	18	1·37082	36		

SODIUM CARBONATE AT 15° C. (Lunge).

Sp. Gr.	Baumé.	Twaddell.	Na_2CO_3 %.	$Na_2CO_3 + 10H_2O$ %.
1·007	1	1·4	0·67	1·807
1·014	2	2·8	1·33	3·587
1·022	3	4·4	2·09	5·637
1·029	4	5·8	2·76	7·444
1·036	5	7·2	3·43	9·251
1·045	6	9·0	4·29	11·570
1·052	7	10·4	4·94	13·323
1·060	8	12·0	5·71	15·400
1·067	9	13·4	6·37	17·180
1·075	10	15·0	7·12	19·203
1·083	11	16·6	7·88	21·252
1·091	12	18·2	8·62	23·248
1·100	13	20·0	9·43	25·432
1·108	14	21·6	10·19	27·482
1·116	15	23·2	10·95	29·532
1·125	16	25·0	11·81	31·851
1·134	17	26·8	12·61	34·009
1·142	18	28·4	13·16	35·493
1·152	19	30·4	14·24	38·405

TABLES VII. AND VIII.

HYDROCHLORIC ACID

(KOLB).

Sp. Gr. at 15° C.	HCl %.	Sp. Gr. at 15° C.	HCl %.	Sp. Gr. at 15° C.	HCl %.	Sp. Gr. at 15° C.	HCl %
1·007	1·5	1·067	13·4	1·134	26·6	1·180	35·7
1·014	2·9	1·075	15·0	1·143	28·4	1·185	36·8
1·023	4·5	1·083	16·5	1·152	30·2	1·190	37·9
1·029	5·8	1·091	18·1	1·157	31·2	1·195	39·0
1·036	7·3	1·100	19·9	1·161	32·0	1·199	39·8
1·044	8·9	1·108	21·5	1·166	33·0	1·205	41·2
1·052	10·4	1·116	23·1	1·171	33·9	1·210	42·4
1·060	12·0	1·125	24·8	1·175	34·7	1·212	42·9

NITRIC ACID

(KOLB).

Sp. Gr. at 15° C.	HNO_3 %.	Sp. Gr. at 15° C.	HNO_3 %.	Sp. Gr. at 15° C.	HNO_3 %.	Sp. Gr. at 15° C.	HNO_3 %.
1·007	1·5	1·108	18·0	1·231	37·0	1·384	61·7
1·014	2·6	1·116	19·4	1·242	38·6	1·398	64·5
1·022	4·0	1·125	20·8	1·252	40·3	1·412	67·5
1·029	5·1	1·134	22·2	1·261	41·5	1·426	70·6
1·036	6·3	1·143	23·6	1·275	43·5	1·440	74·4
1·044	7·6	1·152	24·9	1·286	45·0	1·454	78·4
1·052	9·0	1·161	26·3	1·298	47·1	1·470	83·0
1·060	10·2	1·171	27·8	1·309	48·6	1·485	87·1
1·067	11·4	1·180	29·2	1·321	50·7	1·501	92·6
1·075	12·7	1·190	30·7	1·334	52·9	1·516	96·0
1·083	14·0	1·199	32·1	1·346	55·0	1·524	98·0
1·091	15·3	1·210	33·8	1·359	57·3	1·530	100·0
1·100	16·8	1·221	35·5	1·372	59·6		

TABLE IX.

SULPHURIC ACID (LUNGE-ISLER).

Sp. Gr. at 15°—4° C.	Degrees Baumé.	100 parts by weight of pure acid correspond to		1 litre of pure acid contains per kilo.		Sp. Gr. at 15°—4°C.	Degrees Baumé.	100 parts by weight of pure acid correspond to		1 litre of pure acid contains per kilo.	
		SO_3 %.	H_2SO_4 %.	SO_3.	H_2SO_4.			SO_3 %.	H_2SO_4 %.	SO_3.	H_2SO_4.
1·000	0·0	0·07	0·09	0·001	0·001	1·010	54·7	56·68	69·43	0·913	1·118
1·005	0·7	0·68	0·83	0·007	0·008	1·620	55·2	57·40	70·32	0·930	1·139
1·010	1·4	1·28	1·57	0·013	0·016	1·630	55·8	58·09	71·16	0·947	1·160
1·020	2·7	2·47	3·03	0·025	0·031	1·640	56·3	59·10	72·40	0·972	1·192
1·030	4·1	3·67	4·49	0·038	0·046	1·650	56·9	59·45	72·82	0·981	1·202
1·045	6·0	5·46	6·67	0·057	0·071	1·660	57·4	60·11	73·64	0·998	1·222
1·060	8·0	7·15	8·77	0·076	0·093	1·670	57·9	60·82	74·51	1·016	1·244
1·075	10·0	8·90	10·90	0·096	0·117	1·680	58·4	61·57	75·42	1·034	1·267
1·100	13·0	11·71	14·35	0·129	0·158	1·690	58·9	62·29	76·30	1·053	1·289
1·125	16·0	14·42	17·66	0·162	0·199	1·700	59·5	63·00	77·17	1·071	1·312
1·140	17·7	16·01	19·61	0·183	0·223	1·710	60·0	63·70	78·04	1·089	1·334
1·160	19·8	18·11	22·19	0·210	0·257	1·720	60·4	64·43	78·92	1·108	1·357
1·180	22·0	20·21	24·76	0·238	0·292	1·730	60·9	65·14	79·80	1·127	1·381
1·190	23·0	21·26	26·04	0·253	0·310	1·740	61·4	65·86	80·68	1·146	1·404
1·200	24·0	22·30	27·32	0·268	0·328	1·750	61·8	66·58	81·56	1·165	1·427
1·220	29·0	24·36	29·84	0·297	0·364	1·760	62·3	67·30	82·44	1·185	1·451
1·265	31·1	29·62	36·29	0·377	0·462	1·770	62·8	68·02	83·32	1·204	1·475
1·320	35·0	33·88	41·50	0·447	0·548	1·780	63·2	68·98	84·50	1·228	1·504
1·370	39·0	38·32	46·94	0·525	0·643	1·790	63·7	69·96	85·70	1·252	1·534
1·385	40·1	39·62	48·53	0·549	0·672	1·800	64·2	70·94	86·90	1·277	1·564
1·410	42·0	41·76	51·15	0·589	0·721	1·810	64·6	72·08	88·30	1·305	1·598
1·455	45·1	45·31	55·50	0·659	0·808	1·820	65·0	73·51	90·05	1·338	1·639
1·510	48·1	48·73	59·70	0·751	0·896	1·830	65·5	75·35	92·30	1·380	1·690
1·539	50·0	51·04	62·53	0·781	0·957	1·840	65·9	78·04	95·60	1·436	1·759
1·565	52·1	53·46	65·49	0·837	1·025	1·841	—	79·19	97·00	1·458	1·786
1·580	53·0	54·46	66·71	0·861	1·054	1·842	66·0	81·60	100·00	1·523	1·842
1·601	54·1	55·93	68·51	0·895	1·096						

TABLE X.

SPECIFIC GRAVITY OF PHOSPHORIC ACID (ORTHO) AT 15° C., AND ITS CONTENT IN H_3PO_4 AND P_2O_5.

Sp. Gr.	H_3PO_4 %.	P_2O_5 %.	Sp. Gr.	H_3PO_4 %.	P_2O_5 %.	Sp. Gr.	H_3PO_4 %.	P_2O_5 %.
1·0054	1	1·726	1·1262	21	15·246	1·2731	41	29·766
1·0109	2	1·452	1·1329	22	15·972	1·2812	42	30·492
1·0164	3	2·178	1·1397	23	16·698	1·2894	43	31·218
1·0220	4	2·904	1·1465	24	17·424	1·2976	44	31·944
1·0276	5	3·630	1·1534	25	18·150	1·3059	45	32·670
1·0333	6	4·356	1·1604	26	18·876	1·3143	46	33·496
1·0390	7	5·082	1·1674	27	19·602	1·3227	47	34·222
1·0449	8	5·808	1·1745	28	20·328	1·3313	48	34·948
1·0508	9	6·534	1·1817	29	21·054	1·3399	49	35·674
1·0567	10	7·260	1·1889	30	21·780	1·3486	50	36·400
1·0627	11	7·986	1·1962	31	22·506	1·3573	51	37·126
1·0688	12	8·712	1·2036	32	23·232	1·3661	52	37·852
1·0749	13	9·438	1·2111	33	23·058	1·3750	53	38·578
1·0811	14	10·164	1·2186	34	24·664	1·3840	54	39·304
1·0874	15	10·890	1·2262	35	25·410	1·3931	55	40·030
1·0937	16	11·616	1·2338	36	26·136	1·4022	56	40·756
1·1001	17	12·342	1·2415	37	26·862	1·4114	57	41·482
1·1065	18	13·068	1·2493	38	27·588	1·4207	58	42·208
1·1130	19	13·794	1·2572	39	28·314	1·4301	59	42·934
1·1196	20	14·520	1·2651	40	29·040	1·4395	60	43·660

TABLE XI.

SPECIFIC GRAVITY OF ACETIC ACID AT 15° C. (OUDEMANS).

Sp. Gr.	$C_2H_4O_2$ %	Sp. Gr.	$C_2H_4O_2$ %	Sp. Gr.	$C_2H_4O_2$ %	Sp. Gr.	$C_2H_4O_2$ %
0·9992	0	1·0363	26	1·0631	52	1·0748	77
1·0007	1	1·0375	27	1·0638	53	1·0748	78
1·0022	2	1·0388	28	1·0646	54	1·0748	79
1·0037	3	1·0400	29	1·0653	55	1·0748	80
1·0052	4	1·0412	30	1·0660	56	1·0747	81
1·0067	5	1·0424	31	1·0666	57	1·0746	82
1·0083	6	1·0436	32	1·0673	58	1·0744	83
1·0098	7	1·0447	33	1·0679	59	1·0742	84
1·0113	8	1·0459	34	1·0685	60	1·0739	85
1·0127	9	1·0470	35	1·0691	61	1·0736	86
1·0142	10	1·0481	36	1·0697	62	1·0731	87
1·0157	11	1·0492	37	1·0702	63	1·0726	88
1·0171	12	1·0502	38	1·0707	64	1·0720	89
1·0185	13	1·0513	39	1·0712	65	1·0713	90
1·0200	14	1·0523	40	1·0717	66	1·0705	91
1·0214	15	1·0533	41	1·0721	67	1·0696	92
1·0228	16	1·0543	42	1·0725	68	1·0686	93
1·0242	17	1·0552	43	1·0729	69	1·0674	94
1·0256	18	1·0562	44	1·0733	70	1·0660	95
1·0270	19	1·0571	45	1·0737	71	1·0644	96
1·0284	20	1·0580	46	1·0740	72	1·0625	97
1·0298	21	1·0589	47	1·0742	73	1·0604	98
1·0311	22	1·0598	48	1·0744	74	1·0580	99
1·0324	23	1·0607	49	1·0746	75	1·0553	100
1·0337	24	1·0615	50	1·0747	76		
1·0350	25	1·0623	51				

TABLE XII.

METHYL ALCOHOL (DITTMAR-FAWSITT).

% by Weight.	Sp. Gr. at 0° C.	Sp. Gr. at 15·56° C.	% by Weight.	Sp. Gr. at 0° C.	Sp. Gr. at 15·56° C.
1	0·99806	0·99729	63	0·90276	0·89133
2	0·99631	0·99554	64	0·90056	0·88905
4	0·99299	0·99214	65	0·89835	0·88676
6	0·98990	0·98893	66	0·89611	0·88443
8	0·98701	0·98569	67	0·89384	0·88208
10	0·98429	0·98262	68	0·89145	0·87970
12	0·98171	0·97962	69	0·88922	0·87714
14	0·97926	0·97668	70	0·88687	0·87487
16	0·97689	0·97379	71	0·88470	0·87262
18	0·97459	0·97039	72	0·88237	0·87021
20	0·97233	0·96808	73	0·88003	0·86779
22	0·97007	0·96524	74	0·87767	0·86535
24	0·96780	0·96238	75	0·87530	0·86290
26	0·96549	0·95949	76	0·87290	0·86042
28	0·96310	0·95655	77	0·87049	0·85793
30	0·96057	0·95355	78	0·86806	0·85542
32	0·95783	0·95053	79	0·86561	0·85290
34	0·95500	0·94732	80	0·86314	0·85035
36	0·95204	0·94399	81	0·86066	0·84779
38	0·94895	0·94055	82	0·85816	0·84521
40	0·94571	0·93697	83	0·85504	0·84262
42	0·94239	0·93335	84	0·85310	0·84001
44	0·93911	0·92975	85	0·85055	0·83738
46	0·93575	0·92610	86	0·84798	0·83473
48	0·93229	0·92237	87	0·84539	0·83207
50	0·92873	0·91855	88	0·84278	0·82938
51	0·92691	0·91661	89	0·84015	0·82668
52	0·92507	0·91465	90	0·83751	0·82396
53	0·92320	0·91267	91	0·83485	0·82123
54	0·92130	0·91066	92	0·83218	0·81849
55	0·91938	0·90863	93	0·82948	0·81572
56	0·91742	0·90657	94	0·82677	0·81293
57	0·91544	0·90450	95	0·82404	0·81013
58	0·91343	0·90239	96	0·82129	0·80731
59	0·91139	0·90026	97	0·81853	0·80448
60	0·90917	0·89798	98	0·81576	0·80164
61	0·90706	0·89580	99	0·81295	0·79876
62	0·90492	0·89358	100	0·81015	0·79589

TABLE XIII.

ETHYL ALCOHOL.

PERCENTAGE OF ALCOHOL BY VOLUME AND SPECIFIC GRAVITY COMPARED WITH WATER AT 15° C.

Alcohol %.	Sp. Gr.	Alcohol %.	Sp. Gr.	Alcohol %.	Sp. Gr.
1	0·99844	35	0·95923	69	0·89274
2	0·99695	36	0·95786	70	0·89029
3	0·99552	37	0·95645	71	0·88781
4	0·99413	38	0·95499	72	0·88531
5	0·99277	39	0·95350	73	0·88278
6	0·99145	40	0·95196	74	0·88022
7	0·99016	41	0·95020	75	0·87763
8	0·98891	42	0·94872	76	0·87500
9	0·98770	43	0·94705	77	0·87234
10	0·98652	44	0·94535	78	0·86965
11	0·98537	45	0·94361	79	0·86692
12	0·98424	46	0·94183	80	0·86416
13	0·98314	47	0·94002	81	0·86137
14	0·98206	48	0·93817	82	0·85854
15	0·98100	49	0·93629	83	0·85567
16	0·97995	50	0·93437	84	0·85275
17	0·97892	51	0·93241	85	0·84979
18	0·97790	52	0·93041	86	0·84678
19	0·97688	53	0·92837	87	0·84372
20	0·97587	54	0·92630	88	0·84060
21	0·97487	55	0·92420	89	0·83741
22	0·97387	56	0·92209	90	0·83415
23	0·97286	57	0·91997	91	0·83081
24	0·97185	58	0·91784	92	0·82738
25	0·97084	59	0·91569	93	0·82385
26	0·96981	60	0·91351	94	0·82020
27	0·96876	61	0·91130	95	0·81641
28	0·96769	62	0·90907	96	0·81245
29	0·96659	63	0·90682	97	0·80829
30	0·96545	64	0·90454	98	0·80390
31	0·96428	65	0·90224	99	0·79926
32	0·96307	66	0·89991	100	0·79433
33	0·96183	67	0·89755	—	—
34	0·96055	68	0·89516	—	—

TABLE XIV.

ETHYL ALCOHOL.

SPECIFIC GRAVITY AND PERCENTAGE BY VOLUME AT 15·05° C.

WATER = 0·9991 (TRALLES).

Vol. % Alcohol.	Sp Gr	Vol. % Alcohol	Sp Gr	Vol. % Alcohol	Sp Gr.
1	0·9976	35	0·9583	69	0·8917
2	0·9961	36	0·9570	70	0·8892
3	0·9947	37	0·9559	71	0·8867
4	0·9933	38	0·9541	72	0·8842
5	0·9919	39	0·9526	73	0·8817
6	0·9906	40	0·9510	74	0·8791
7	0·9893	41	0·9494	75	0·8765
8	0·9881	42	0·9478	76	0·8739
9	0·9869	43	0·9461	77	0·8712
10	0·9857	44	0·9444	78	0·8685
11	0·9845	45	0·9427	79	0·8658
12	0·9834	46	0·9409	80	0·8651
13	0·9823	47	0·9391	81	0·8603
14	0·9812	48	0·9373	82	0·8575
15	0·9802	49	0·9354	83	0·8547
16	0·9791	50	0·9335	84	0·8518
17	0·9781	51	0·9315	85	0 8488
18	0·9771	52	0·9295	86	0·8458
19	0·9761	53	0·9255	87	0·8428
20	0·9751	54	0·9245	88	0·8397
21	0·9741	55	0·9234	89	0·8365
22	0·9731	56	0·9213	90	0·8332
23	0·9720	57	0·9192	91	0·8299
24	0·9710	58	0·9170	92	0·8265
25	0·9700	59	0 9148	93	0·8230
26	0·9689	60	0·9126	94	0·8194
27	0·9679	61	0·9104	95	0·8157
28	0·9668	62	0·9082	96	0·8118
29	0·9657	63	0·9059	97	0·8077
30	0·9646	64	0·9036	98	0·8034
31	0·9634	65	0·9013	99	0·7988
32	0·9622	66	0·8989	100	0·7939
33	0·9609	67	0·8695	—	—
34	0·9596	68	0·8941	—	—

TABLE XV.

ETHYL ALCOHOL.

SPECIFIC GRAVITY OF ALCOHOL AT VARIOUS TEMPERATURES. H_2O at 4° C = 1 (MENDELEJEFF).

% by Weight.	Sp. Gr. at 0° C.	Sp. Gr. at 10° C.	Sp. Gr. at 20° C.	Sp. Gr. at 30° C.
0	0·99988	0·99975	0·99831	0·99579
5	0·99135	0·99113	0·98945	0·98680
10	0·98493	0·98409	0·98195	0·97892
15	0·97995	0·97816	0·97527	0·97142
20	0·97566	0·97263	0·96877	0·96413
25	0·97115	0·96672	0·96185	0·95628
30	0·96540	0·95998	0·95403	0·94751
35	0·95784	0·95174	0·94514	0·93813
40	0·94939	0·94255	0·93511	0·92787
45	0·93977	0·93254	0·92493	0·91710
50	0·92940	0·92182	0·91400	0·90577
55	0·91848	0·91074	0·90275	0·89456
60	0·90742	0·89944	0·89129	0·88304
65	0·89595	0·88790	0·87961	0·87125
70	0·88420	0·87613	0·86781	0·85925
75	0·87245	0·86427	0·85580	0·84719
80	0·86035	0·85215	0·84366	0·83483
85	0·84789	0·83967	0·83115	0·82232
90	0·83482	0·82665	0·81801	0·80918
95	0·82119	0·81291	0·80433	0·79553
100	0·80625	0·79788	0·78945	0·78096

TABLE XVI.

GLYCERIN.

% H_2O.	Sp. Gr.	Degrees Baumé	% H_2O.	Sp. Gr.	Degrees Baumé
0·	1·2640	31·2	11·0	1·2350	28·6
0·5	1·2625	31·0	11·5	1·2335	28·4
1·0	1·2612	30·9	12·0	1·2322	28·3
1·5	1·2600	30·8	12·5	1·2307	28·2
2·0	1·2585	30·7	13·0	1·2295	28·0
2·5	1·2575	30·6	13·5	1·2280	27·8
3·0	1·2560	30·4	14·0	1·2270	27·7
3·5	1·2545	30·3	14·5	1·2255	27·6
4·0	1·2532	30·2	15·0	1·2242	27·4
4·5	1·2520	30·1	15·5	1·2230	27·3
5·0	1·2505	30·0	16·0	1·2217	27·2
5·5	1·2490	29·9	16·5	1·2202	27·0
6·0	1·2480	29·8	17·0	1·2190	26·9
6·5	1·2465	29·7	17·5	1·2177	26·8
7·0	1·2455	29·6	18·0	1·2165	26·7
7·5	1·2440	29·5	18·5	1·2150	26·5
8·0	1·2427	29·3	19·0	1·2137	26·4
8·5	1·2412	29·2	19·5	1·2125	26·3
9·0	1·2400	29·0	20·0	1·2112	26·2
9·5	1·2390	28·9	20·5	1·2100	26·0
10·0	1·2375	28·8	21·0	1·2085	25·9
10·5	1·2362	28·7			

TABLE XVII.

DEXTROSE (AT 17·5° C.).

%	Sp. Gr. (1)	Sp. Gr. (2)	%	Sp. Gr. (1)	Sp. Gr. (2)	%	Sp. Gr. (1)	Sp. Gr. (2)	%	Sp. Gr. (1)	Sp. Gr. (2)
1	1·0040	1·0035	20	1·0832	1·0830	39	1·1743	1·1731	57	1·2725	1·2714
2	1·0080	1·0070	21	1·0877	1·0875	40	1·1794	1·1781	58	1·2783	1·2770
3	1·0120	1·0106	22	1·0922	1·0920	41	1·1846	1·1832	59	1·2841	1·2826
4	1·0160	1·0143	23	1·0967	1·0965	42	1·1898	1·1883	60	1·2900	1·2882
5	1·0200	1·0179	24	1·1013	1·1010	43	1·1951	1·1935	61	1·2959	1·2930
6	1·0240	1·0215	25	1·1059	1·1056	44	1·2004	1·1989	62	1·3019	1·2994
7	1·0281	1·0254	26	1·1106	1·1103	45	1·2057	1·2043	63	1·3079	1·3050
8	1·0322	1·0291	27	1·1153	1·1150	46	1·2111	1·2098	64	1·3139	1·3105
9	1·0363	1·0328	28	1·1200	1·1197	47	1·2165	1·2153	65	1·3190	1·3160
10	1·0404	1·0367	29	1·1247	1·1245	48	1·2219	1·2209	66	1·3260	1·3215
11	1·0446	1·0410	30	1·1295	1·1293	49	1·2274	1·2265	67	1·3321	1·3270
12	1·0488	1·0456	31	1·1343	1·1340	50	1·2329	1·2322	68	1·3383	1·3324
13	1·0530	1·0504	32	1·1391	1·1388	51	1·2385	1·2378	69	1·3445	1·3377
14	1·0572	1·0552	33	1·1440	1·1436	52	1·2441	1·2434	70	1·3507	1·3430
15	1·0614	1·0600	34	1·1490	1·1484	53	1·2479	1·2490	71	1·3570	1·3483
16	1·0657	1·0647	35	1·1540	1·1533	54	1·2553	1·2546	72	1·3633	1·3535
17	1·0700	1·0693	36	1·1590	1·1582	55	1·2610	1·2602	73	1·3696	1·3587
18	1·0744	1·0738	37	1·1641	1·1631	56	1·2667	1·2658	74	1·3760	1·3658
19	1·0788	1·0784	38	1·1692	1·1681						

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